THURSDAY, MARCH 15, 1900.

## SUGARS AND THEIR DERIVATIVES.

*Les Sucres et leurs principaux Dérivés.* Par L. Maquenne, Professeur au Muséum d'Histoire Naturelle. Pp. ii + 1032. (Paris: Georges Carré and C. Naud, 1900.)

THERE is no class of carbon compounds of greater interest to chemists and biologists than the sugars or, in the wider sense, the carbohydrates which form the subject of Prof. Maquenne's volume. Whether regarded from the point of view of the physiologist, who concerns himself with the part played by these compounds in the vital processes of animals and plants, or whether considered in their chemical aspect, as furnishing the most striking illustrations of the new stereo-chemistry of Le Bel and Van 't Hoff, the sugars will always be found most fascinating subjects for study and research. The great impetus to the development of our knowledge of these compounds, given by the classical researches of Emil Fischer, is one of the most remarkable examples of the interdependence of hypothesis and experiment that can be furnished by modern science—a point which is recognised by the author of the present work in the preface:—

"C'est en effet sur les travaux de E. Fischer que les considérations d'isomérie dans l'espace ont trouvé leur plus solide appui et la doctrine du carbone asymétrique ses plus sérieuses vérifications."

The continuously growing knowledge of the carbohydrates resulting from the labours of many chemists and physiologists, renders it impossible for the non-expert student to keep pace with the numerous discoveries which are being announced in rapid succession in the various publications recognised by scientific workers. As with every branch of science in which the rate of development is a measure of its vitality, specialisation must be recognised as a necessary condition of progress, and all workers must be grateful when specialists like Prof. Maquenne go through the laborious process of taking stock of existing knowledge, and of bringing together into a coherent form the scattered information which is otherwise so difficult to obtain without a large library at one's elbow. Such monographs form landmarks in the history of science; if in a few years this or any similar work is found to be behind the actual state of knowledge, it is no disparagement to the author, but an indication of progress which every worker in science cannot but welcome. As examples of the way in which the subject is growing, it may be mentioned that even while the present work has been in the hands of its reviewer, a new synthesis of glucose, fructose and mannose has been made possible by the discovery by Messrs. Fenton and Jackson, that glycollic aldehyde gives a mixture of α- and β-acrose under the influence of alkali; while, still more recently, a transition from glucose to *d*-erythrose and *i*-erythritol *viâ d*-arabinose and *d*-arabonic acid has been effected by Ruff.[1]

The name of M. Maquenne is familiar in this department of chemistry, and his qualifications for the task which he has undertaken will be generally admitted. A critical review of such a work as that before us is out of the question; we can only indicate its contents and describe the author's mode of treatment. In classification and logical sequence and general clearness the work is up to that high standard which is characteristic of French writers on scientific subjects. The twenty chapters into which the book is divided are classified under six parts. The first part (two chapters) deals with generalities and syntheses; the second part (six chapters) with the polyatomic (in our nomenclature polyhydric) alcohols classified according to the number of carbon atoms, as tetrites, pentites, hexites, &c.; the third part (four chapters) comprises reducing sugars, again classified as trioses, tetroses, &c.; the fourth part (two chapters) deals with hydrolysable sugars, such as bioses, trioses and polyoses; the fifth part (three chapters) with acid derivatives of the sugars; and the sixth part (three chapters) with miscellaneous compounds, such as osones, osamines and saccharines.

As a work of the present class is, in the first place, valuable as a book of reference, it may be pointed out that there is a fairly ample index alphabetically arranged, the very excellent plan of printing the number of the page containing the main reference to the compound in thick type being systematically adopted. The French custom of printing the table of contents at the end of the volume, instead of at the beginning, appears to us, without prejudice (insular or otherwise), to be a bad one. It will be noticed also that the nomenclature adopted for the "sugars" proper leads to the use of the term triose in two distinct senses—viz. for compounds like glyceraldehyde and dioxyacetone, which contain three atoms of carbon, and for sugars like raffinose and melizitose, which contain three hexose complexes. But these are minor points. The general arrangement of the chapters will be found, on detailed examination, to be carried out on a uniform plan, so that the reader who is searching for any particular kind of information concerning any individual carbohydrate will soon become familiar with the author's arrangement, and will know where to look for such information. We have had occasion frequently to test the book in this way, and, so far as our experience goes, M. Maquenne has never failed us. Beyond this, of course, a reviewer cannot go in praise of the work which has been submitted to his judgment.

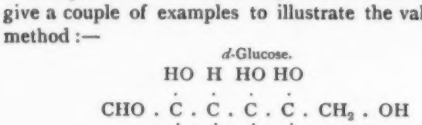
The arrangement of the subject-matter is capable of being briefly explained. Each part begins with a chapter of generalities relating to the whole group comprised under the part, and each succeeding chapter treats of the individual compounds in the same systematic way, viz. occurrence and natural history, preparation, synthesis when accomplished, chemical constitution and configuration, physical properties, chemical properties such as action of heat, oxidation, reduction, action of acids, action of bases and salts, action of alcohols (*i.e.* etherification), phenols, aldehydes and ketones, amines, hydrazines, and miscellaneous reagents, fermentability and methods of detection and estimation. From this synopsis, which may be taken as representative for the most complete case of a widely distributed and well-known sugar, such

[1] *Ber. deutsch. ch. Gesell.*, January 1900, vol. 32, p. 3672.

as *d*-glucose, it is evident that the chemist and physicist, the physiologist, the analyst and the technologist concerned with fermentation industries are all catered for by the author, and in such a way that there should be very little difficulty in finding out what is known concerning any particular sugar or carbohydrate from the special point of view from which the reader consults the volume.

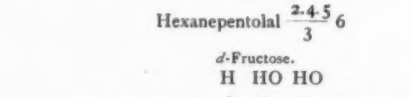
There are a few other points to which attention may be directed. The systematising of the nomenclature, so as to bring the latter into harmony with the stereochemical formulæ, is more complete than has hitherto been attempted in any work dealing with this class of compounds. The numerical system of indicating position in the space-formula is certainly to be commended. We give a couple of examples to illustrate the value of the method :—

*d*-Glucose.



Hexanepentolal $\frac{2\cdot4\cdot5}{3}6$

*d*-Fructose.



Hexanepentol – 1 $\frac{4\cdot5}{3}$ 6-one-2

Another point which those who have occasion to consult such works will appreciate, is the distribution of the references to original papers among the text, instead of relegating them to footnotes, or, worse still, to the end of the book. Some readers may not agree with this view, but it has been impossible, in writing this notice, to avoid comparing M. Maquenne's volume with a somewhat similar work at present in existence, viz. the "Kurzes Handbuch der Kohlenhydrate," by Dr. Tollens, the first volume of which was published in 1888, and the second in 1895. In the German work the references consist of densely-packed and absolutely bewildering series of pages at the end of the volume, so that in hunting up a reference the reader must turn from the page which he is reading and wade through the serried ranks of numbered references till he finds the one he wants, by which time he will have, no doubt, mislaid the paragraph from which he set out. In making use of such works as the one under consideration, in which the authority for every statement is referred to, it is certainly more convenient to have the references in brackets immediately under the notice of the reader. If the references are not wanted, the reader has only to pass on to the end of the bracket, and begin the following sentence.

This comparison of the French and German works brings out another point, however, in which Dr. Tollens will be found to have the advantage. The complex polyoses, such as starch and cellulose, are treated of much less completely by the French than by the German author, so that in this division Dr. Tollens's book will take precedence as a work of reference. In fact, M. Maquenne refers his readers to the German work for more complete information on these subjects. The other standard German authority on this subject, "Die Chemie der Zuckerarten," by E. O. v. Lippmann (1895), will find a serious rival in the present work.

In favourably recommending this latest contribution to the chemical literature of the carbohydrates to the attention of English chemists as a work of the greatest value to the general student, and as indispensable to the specialist, we have only to utter the caution—perhaps somewhat unnecessarily—that M. Maquenne does not profess to deal with his subject from the technological point of view. It may prevent disappointment if we point out that the manufacturer who is seeking for information concerning construction of plant, processes of extraction, refining, and so forth, will have to look elsewhere for guidance. Of the general value of the present volume as a literary production, we have only to say that the information given is complete, accurate, and up to date. The only omission that we have been enabled to detect relates to *d*-mannose, of which the author says (p. 559) :—

"Malgré ses rapports avec celle-ci [*d*-mannite] et ses analogies de constitution avec le glucose et le lévulose, il ne parait exister chez les plantes, comme le galactose, qu'à l'état de *mannosides* complexes," &c.

The occurrence of free mannose in plants is, therefore, not recognised by M. Maquenne. Nevertheless, Messrs. Tsukamoto, Tsuji, and Kinoshita are said to have extracted this sugar from the stalks of the Japanese *Amorphophallus konjak*, and Messrs. Flatau and Labbé have recently announced that the sugar contained in orange peel is mannose.[1] The author may have overlooked these statements, or he may not accept them; at any rate, it seems worth while calling attention to the omission.

R. MELDOLA.

## *A NEW BOOK ON MAN.*

*The Races of Man: an Outline of Anthropology and Ethnography.* By J. Deniker. With 176 illustrations and two maps. Pp. 611. (London: Walter Scott, Ltd., 1900).

THE Contemporary Science Series has been enriched by the addition of this very valuable work on general anthropology by Dr. J. Deniker, the distinguished Chief Librarian of the Museum of Natural History in Paris, who is well known for his original contributions to that science. Dr. Deniker has read widely, and at various times has systematised the writings of others. These are necessary qualifications for the writer of a general survey of the science of man; but in addition, our author has made investigations in various departments of physical anthropology which give a precision to his treatment, and this element of first-hand knowledge causes the reader to feel more reliance on his judgment than might otherwise have been the case.

The book is fairly evenly divided between a summary of the scope of physical anthropology and ethnography, and a systematic account of races and peoples. The former section deals with somatic characters, such as the distinctive characters of man and apes, the morpho-

[1] *Bull. Soc. Chim.* [3] xix. 408.

logical characters of human races, and their physiological and psychological characters. The chapters on the social life of men are prefaced by a useful classification of states of civilisation. One chapter is devoted to the various methods of the exchange of ideas, and others deal with the factors of material life, such as food, fire, pottery and habitations; in the latter section, the author draws attention to the essential distinction between fixed and removable dwellings. The view is adopted that, in warm climates, vanity begot ornaments which became transformed little by little into dress.

The chapter on the psychic life alludes to games and recreations, fine arts, religion, myths and science. Finally, there is one chapter devoted to family life, and another to social life.

With such a wide field to cover, the accounts of the multitudinous aspects of human life must of necessity be brief; but the author has maintained an admirable perspective, and his descriptions are written clearly and tersely, with no attempt at "fine writing." As Dr. Deniker gives copious references, the reader will have no difficulty in finding fuller information on any particular subject, and his hope that "even professional anthropologists" will be able to consult his works profitably is well founded; the tables of measurements and indices are in this respect particularly useful. The book is well illustrated, the racial types being very carefully chosen. The introduction of more maps illustrating the distribution of the principal groups would have increased the value of the book.

It is impossible in a book of this nature to avoid slips of various kinds. For example, on p. 65, in the explanation of Fig. 13, K is twice printed for X; Bornea is printed for Borneo, pp. 486, 487; and there are a few other obvious misprints. On dealing with the question of anthropophagy (p. 147), it should be noted that the abandonment of cannibalism by the Fijians is very recent, and that was due to the pressure brought to bear on them by Europeans; the same applies to several tribes in New Guinea, but in others the practice still continues. The fire-syringe (p. 150) is known in Java, and the sawing method of making fire in New Guinea. The fish-hook ornament of Torres Straits (p. 204) was made of tortoiseshell, not of mother-o'-pearl. Flinders Petrie has for some time abandoned the view that the "new race" was of Libyan origin, and has shown that these people were the neolithic ancestors of the Egyptians (footnote, p. 429).

It is scarcely fair to charge Dr. A. B. Meyer (footnote, p. 483) with supporting the Negrito origin of the Kalangs of Java, as in his original paper in 1877 he did so "with a certain reservation," and he candidly admitted his mistake in his fine monograph on the Negritos in 1893. Although Dr. Deniker is usually so careful in his references, he has omitted to refer the reader to any of Dr. Meyer's valuable publications, with the exception of this unfortunate instance.

Like most anthropologists, Dr. Deniker employs the term Dyak to signify a native of Borneo. Since the publication of Ling Roth's book on "The Natives of Sarawak," there is little excuse for employing that term in an ambiguous manner, unless, of course, an author, who may be quoted, gives no more precise information. The Land Dayaks inhabit the original Sarawak territory. The Sea Dayaks are a very different people, and equally distinct are the extensive groups of Kenyahs, Punans, Muruts, &c.; but, as no precise anthropometrical data were available when the book was written, it is unreasonable to expect a thorough disentangling of the complex of peoples in this large island. Suffice it to say, that a pronounced dolichocephalic element is present, which is probably that recognised by Dr. Deniker as Indonesian.

Dr. Deniker states (p. 486):—

"It is even possible that the Malays are a mixed nation, sprung from the intermixture of Indonesians with various Burmese, Negrito, Hindu, Chinese, Papuan, and other elements. In this case, the Indonesians would be the pure Malay type, the real proto-Malays."

It is probable that the "Malays" everywhere are a mixed people, and have a different composition in various localities, but our author appears to have overlooked what would be the probable effect of a mixture of most of these elements on the cephalic index of his proto-Malays. He states that the Indonesians have a cephalic index of 78·5 while the Malays have an index of 85. The Burmese index and that of the Aeta Negritos is somewhat less than this, while that of the Sakais is about 79. The Southern Chinese have an index of 81, and Hindus (*i.e.* Talugus or Klings) and the Papuans are markedly dolichocephalic. It is, then, difficult to see how the brachycephaly could have arisen; on p. 590 the presumably fairly pure Sumatran Malays are put down as 82·8, but though this lessens, it does not do away with this difficulty.

There is no particular reason for the surprise of M. Sénart (p. 404) at Brahmans offering water to travellers at railway stations; a high caste Hindu could not receive water from one of low caste, and by the simple expedient of avoiding absolute contact of person or vessel no contamination is received from giving water to low caste Hindus.

The Kolarians (p. 408) have a tradition that they came from the North-east, and they may be the remains of one of the various migrations which have assisted towards forming the complex population of India. This does not necessarily imply that they have a Mongolian strain. Sir William Turner has recently[1] investigated the craniology of the Hill Tribes of the North-east Frontier, and he identifies a dolichocephalic, non-Mongolian element, which appears to the present writer to be akin to the Indonesian stock. Some authorities regard the true Dravidians as the more or less modified relics of another, and possibly later, migration from the North-west, which partially replaced and submerged the Kolarian stock.

A special feature in the book is the classification of the peoples of Europe. He recognises: (1) a Northern Race (fair, dolichocephalic, very tall); (2) an Eastern Race (fair, sub-brachycephalic, short); (3) an Ibero-Insular Race (dark, dolichocephalic, short); (4) a Western or Cevenole Race (dark, very brachycephalic, short); (5) a Littoral or Atlanto-Mediterranean Race (dark, mesocephalic, tall); (6) an Adriatic or Dinaric Race (dark, brachycephalic, tall), and several sub-races. The first, third, and fourth of these races are commonly accepted, and there will probably be some discussion concerning

[1] "Contributions to the Craniology of the People of the Empire of India. Part I." *Trans.* Roy. Soc. Edinb. xxxix. 1899, pp. 703.

the other three ; but those who are interested in this subject will have to study the series of memoirs on "Les Races de l'Europe," by Dr. Deniker, of which the first instalment on the cephalic index has been published by l'Association Française pour l'Avancement des Sciences (26e Session, 1897), 1899. In the volume under review there are, owing to the necessary limits of space, insufficient data to profitably discuss the author's position. It is evident that Dr. Deniker has published the conclusions which he has already arrived at from a study of the large amount of facts he has accumulated, and of which one valuable section has alone yet been published. Unfortunately, many anthropological terms are insufficiently fixed, and all authors are not careful to promote uniformity of definition—the term "race" is a case in point—and our author admits of more races in Europe than do other anthropologists ; indeed, in his treatment of European ethnography he is more analytic than synthetic.

It is always easy to criticise ; especially does a book like this lend itself to captious reviewing ; but it is not every one who could write so sound and clear a summary of the scattered information that has been accumulated on an intricate subject. A. C. HADDON.

## SYSTEMATIC BACTERIOLOGY.

*System der Bakterien.* Von Dr. W. Migula. Zweiter Band, Specielle Systematik der Bakterien. Pp. x + 1068 + xviii Plates. (Jena : Gustav Fischer, 1900.)

THIS volume is the second part of a work, of which the first part was reviewed in this journal in June 1898. It was then pointed out how meritorious was this undertaking of Prof. Migula, well known by his researches into the morphology of bacteria and allied organisms, in attempting to scientifically group the enormous number of forms of bacteria that had been discovered and described. No better index for the great difficulties of classifying bacteria in a scientific manner need be adduced than the fact that bacteriology within the last fifteen or twenty years has advanced by leaps and bounds, and that a host of workers—botanists, chemists, and last, but not least, pathologists—have been busy in discovering new forms, and describing and classifying them in any but a scientific manner, and on principles widely differing according to the actual point of view of the individual observers.

To classify and systematise on scientific principles, such as obtain in other departments of natural history, is a task which demands an enormous amount of labour and a comprehensive knowledge, which few observers would be willing to spare or able to command. Prof. Migula is to be congratulated on having, with his thorough grasp of this new and ever-widening field of research, and with a truly prodigious industry, achieved this result in as thorough a manner as can be expected in a branch of natural history so new and so growing as systematic bacteriology.

It will be remembered that in the first volume bacteria were considered in a general way as to their morphology and activity, and by these studies the endless number of bacterial species received their proper and scientific allocation. Thus the bacteria, as a "class," were arranged in two great groups or "orders," viz. : (1) Eubacteria, free of sulfurgranules and bacteriopurpurin, and (2) Thiobacteria, including sulfurgranules, and their protoplasm either colourless or coloured by bacteriopurpurin (pink, red or violet).

The "order" of Eubacteria comprises four "families" : (*a*) Coccaceæ, cells spherical ; (*b*) Bacteriaceæ, cells rod-shaped or cylindrical ; (*c*) Spirillaceæ, cells more or less curved and spiral ; (*d*) Chlamydobacteriaceæ, cells cylindrical, arranged in threads surrounded by a common sheath.

The first family, Coccaceæ, comprises five "genera," viz. : genus 1, Streptococcus or Chaincocci ; genus 2, Micrococcus ; genus 3, Sarcina ; genus 4, Planococcus ; genus 5, Planosarcina.

Genus Streptococcus comprises 50 different known species; genus Micrococcus comprises 228 ; genus Sarcina comprises 55 ; genus Planococcus, 7 ; and genus Planosarcina three distinct known species.

The second family, Bacteriaceæ, is divided into three genera, viz. : genus 1, Bacterium, without flagella, comprising 302 different species ; genus 2, Bacillus, flagella more or less over the whole body, comprising 452 species ; and genus 3, Pseudomonas, flagella only at the ends, comprising 79 different species.

The third family, Spirillaceæ, is divided into four genera, viz. : genus 1, Spirosoma, with 7 species ; genus 2, Microspira, with 68 ; genus 3, Spirilla, with 16 ; and genus 4, Spirochæta, with five different species. These three families are minutely dealt with in 1030 pages ; the whole of the fourth family of Chlamydobacteriaceæ, with its four genera and nine species, and the whole of the second "order" of Thiobacteria, with its two families (five genera), and comprising twelve species, altogether receive only twenty pages, so that practically the volume is devoted to a description of Coccaceæ, Bacteriaceæ and Spirillaceæ.

In looking over the description of the 1272 species belonging to these three families, and while admiring the prodigious labour, one cannot help sympathising with the author in the difficulties to determine which is, and which is not, a true species ; which is, or is not, merely a variety ; so much so that it seems as if in distinguishing "species" from "varieties," and *vice versa*, a certain arbitrary plan had to be followed. For, in some instances, the distinction between one "true" species and another is based chiefly on very slight cultural differences in one or the other artificial medium ; in others on minute details of artificial staining, or on slight differences in size on one or the other artificial mediums ; or even slight shades of natural colouring on a particular medium, or slight differences in physiological action. That is to say, numerous instances occur where one or the other of these points is used for distinguishing one species from another, and other equally conspicuous instances occur where these differences only suffice to mark off a "variety." One example will suffice to illustrate this difficulty. In the genus Streptococcus, the first species dealt with is that of "Streptococcus pyogenes" of Rosenbach ; to this "species" the author assigns as

"varieties" the Streptococcus erysipelatos, the Streptococcus conglomeratus (Streptoc. scarlatinæ), the Streptococcus brevis and longus, Streptococcus murisepticus, and Streptococcus septo-pyæmicus. According to the author, the differences in size, arrangement, cultural characters and physiological action of these "varieties" and the "Streptococcus pyogenes" are slight, and do not justify a separation as true species. Now, any one who has had sufficient experience in the matter of these so-called "varieties" must know that the cultural and physiological differences between these "varieties" and the "species" are sufficiently definite and conspicuous; in fact, quite as definite as those described of several others of the author's true "species" of Streptococcus.

The same difficulty is met with in looking over some of the species of the genus Micrococcus, Bacterium and Bacillus. As mentioned above, the chief distinction between genus Bacterium and Bacillus is the absence or presence of flagella; now looking through the description of some of the species belonging to "Bacterium," we find several in which the absence of flagella is deduced apparently solely from the fact that in the fresh state (hanging drop) no mobility is observed; but this, as is well known, is deceptive for a true diagnosis, and no safe reliance can be placed on it. In the same way we find some species of "bacillus," *e.g.* bacillus pestis, as being surrounded by flagella. I have no doubt this statement will come to many as a surprise, and one would like to know whether this bacillus pestis of Migula had been tested on animals and had caused the typical disease.

The volume contains at the end eighteen plates, each with eight figures of clear and good prints of photographic representations of many species of Coccaceæ, Bacteriaceæ and Spirillaceæ. Many of the figures are excellent, *e.g.* those of Flagellate bacilli, Pseudomonas and Spirillaceæ; some others might without disadvantage have been omitted as not representative or too little representative; *e.g.* there occur five figures of *Vibrio cholerae asiaticae* [Microspira Comma (Migula)], not one of which is really characteristic of the microbe.

The important points of the formation, appearance and distributions of spores in many bacillary species, is represented by a single figure (Fig. 2, Plate iv.) showing dots in anthrax threads supposed to have been photographed at a magnification of 1000 (!).

The book on the whole must occupy an important place not only as a thoroughly systematic work, but also as a book of reference, there being attached to each species a valuable paragraph of bibliography.

E. KLEIN.

## *COLLECTED WORKS OF L. LORENZ.*

*Œuvres Scientifiques de L. Lorenz. Revues et Annotées.* Par H. Valentiner. Tome Premier, Deuxième Fascicule; Tome Sécond, Premier Fascicule. Pp. 213+529 and 315. (Copenhague: Lehmann and Stage, 1898 and 1899.)

THE custom of collecting into convenient form the works of a distinguished writer has much to recommend it. We in England have realised its importance, and we gladly welcome this edition of the collected works of Prof. L. Lorenz, two parts of which are now before us, published in French, at Copenhagen, under the editorship of Dr. H. Valentiner, and at the cost of the Carlsberg Foundation. The two volumes cover a wide period of time; the first paper, that containing Prof. Lorenz's theoretical and experimental researches on indices of refraction, was printed in 1869. The author's name is well known as one who has worked at optical theory, and has carried out experiments of great importance with a view to the verification of crucial points in that theory. The phenomena of dispersion, and the relations between the optical properties and the physical conditions of a substance, offer a fascinating field of research; and it is of real service to have here, in accessible form, the elaborate series of papers which led Lorenz to the conclusion that the quantity $(\mu^2-1)/(\mu^2+2)\rho$ was a constant for the various states of a refracting medium. This is hardly the place to discuss at length the various steps that lead the author to that conclusion. In Lorenz's view the ether inside a transparent medium, such as glass or water, cannot be treated as homogeneous. His solution of the problem is most easily followed in the paper, "Ueber die Refractions Constante" (*Wied. Ann.* tome xi.), the mathematical developments of which are given on p. 360 of the first volume now under consideration. Lorenz assumes, in this paper, that within the molecules of a transparent body the velocity of light is constant, and in the interspaces between the molecules it is also constant; the actually observed velocity will depend on these two constants. In the paper now before us it is assumed further, though this is shown not to be vital to the result, that the molecules are spheres. The problem thus discussed is that of the transmission of light through a complex medium consisting of transparent spheres embedded in a homogeneous medium, and with these assumptions it is shown that the quantity $(\mu_\infty{}^2-1)/(\mu_\infty{}^2+2)$ is proportional to the mass per unit volume of the compound medium. In obtaining the above equation, the effects of dispersion are neglected; a later paper (*Wied. Ann.* tome xx.) discusses these on the assumptions (1) that the density of the ether near any molecule is a function of the distance from the centre of the molecule, so that the ether is arranged round each molecule in spherical layers, which change in density on passing from one layer to the next; and (2) that Fresnel's sine and tangent formulæ hold for each such transition.

From this Lorenz obtains the equation

$$(\mu^2-\mu_\infty{}^2)/(\mu^2+2\mu_\infty{}^2)\rho=a/\lambda^2+b/\lambda^4+\ \ldots$$

$\mu$ being the refractive index for waves of length $\lambda$, and $\mu_\infty$ that for infinite waves.

Other papers in the volume before us are concerned with experimental investigations into the truth of these formulæ. As a result of one series of experiments, it appears probable (p. 245) that the refractive index of water is a function of the density of the water, and not of the temperature, except so far as that produces change of density; while, in general, Lorenz concludes that for a number of gases and vapours the equation

$$(\mu_\infty{}^2-1)/(\mu_\infty{}^2+2)\rho=a \text{ constant}$$

is satisfied with considerable accuracy.

With regard to this result, it should be noted that (p. 323) the formula is treated as equivalent to

$$2(\mu_\infty - 1)/3\rho = \text{constant},$$

so that the experiments do not decide between the simpler law due to Dr. Gladstone and that given by Lorenz.

In the second volume we have an important memoir, on the solution of the equations of motion of a homogeneous elastic solid, published in 1860 in *Crelle's Journal*, and some interesting speculations on the relation of thermal conductivity to electric conductivity in pure metals; but the papers which will attract most attention are two on the absolute resistance of mercury (*Pogg. Ann.* cxlix., and *Wied. Ann.* xxv.). The first of these gives the original account of the now well-known Lorenz method of measuring absolute resistance; while the second is a statement of the results of Prof. Lorenz's own experiments made at the request of the International Congress of Electricians in 1882.

The first paper is most interesting; the contrast between the original Lorenz apparatus, as figured on p. 88, and the instrument designed by Professors Viriamu Jones and Ayrton for the McGill University is most instructive. Lorenz, from the beginning, was alive to the merits of his method and to the difficulties of carrying it into practice; the first preliminary experiments, in which the diameters of the tubes of mercury, used as resistances to be measured, were 7 millimetres and 14 millimetres respectively, led to the result that the length of a column of mercury one square millimetre in cross-section, and having a resistance of one ohm, is 107 centimetres, a result surprisingly near the truth when all things are considered; while in his definitive paper the result arrived at is 105·9 centimetres; the value which has been universally agreed upon as representing the result of all the best experiments is, as is well known, 106·3 centimetres.

Space compels only the briefest mention of another interesting paper, "On the Propagation of Electricity" (*Wied. Ann.* tome vii.); but enough has been written to show the high value and real interest of these volumes. Students of physics owe a debt of gratitude to Dr. Valentiner for the care with which he has done his work as editor, and for the labour he has spent in explaining difficulties and in making Lorenz's meaning quite clear.

## OUR BOOK SHELF.

*Theory and Practice of Art Enamelling upon Metals.* By Henry Cunynghame. Pp. xvi + 135. (Westminster: Archibald Constable and Co., 1899.)

THIS book treats of enamels and of their employment in artistic work from several points of view. The introductory chapter, which extends to 33 pages out of the 133 which the volume contains, is mainly historical and archæological. The eight plates which illustrate this section of the book are unsatisfactory, while the text is open to serious criticism. The author is mistaken when he describes the Alfred Jewel in the Ashmolean Museum at Oxford as a ring, and when he affirms that it contains a "Byzantine enamel in a Saxon setting." A strange passage, which is too funny to be missed, will be found on p. 7, where the mosque of Santa Sophia at Constantinople is stated to have suffered the destruction of many of its splendid enamels through the "fanaticism of the followers of Dost Mahommed." The practical and technological details of Chapters i. to iv., with the illustrations which explain the operations described in the text, or represent the tools and apparatus employed, constitute the valuable portion of this treatise. One can discern throughout these pages the skilful and intelligent worker who has fought his way to success. We cannot speak of the final chapter, "The Manufacture of Enamels," with equal confidence. It would be wiser to omit chemical formulæ altogether rather than to give $NaO_2BO_3 + 10Aq.$ for borax, $HOBO_3$ for boric acid, $Cu_2O$ for black oxide of copper, $Cr_2O_2$ for sesquioxide of chromium, and $KOCrO_3$ for bichromate of potash. And what is the meaning of this sentence (p. 124), "Manganese is called in German, brown-stone, and by the French, peridot, after a town near Limoges where it was found"?

*The Witness of Creation: Nature Sketches from the Book of Job.* By M. Cordelia Leigh. Pp. 167. (London: Jarrold and Sons, 1900.)

WE hope this book will be widely read by the Sunday-school teachers and leaders of Bible classes, for whom it is primarily intended; for they will derive from it many lessons which will create and foster a love of nature in the members of their classes. The chapters in the book originally appeared in *The Sunday at Home*, each chapter being based on a passage in the Book of Job or the eighth Psalm, in which some natural force or object is referred to, such as the sun, snow, rain, wind, ice, the lion, the wild ass, &c.

The poem of Job is full of references to nature, and Miss Leigh has interpreted these references in the light of modern science. For instance, the words "foundations of the earth" suggest remarks upon the earth's physical structure; "Hast thou entered into the springs of the sea? or hast thou walked in the recesses of the deep?" forms the text for a chapter on the sea; and "Canst thou send forth lightnings, that they may go, and say unto thee, Here we are?" heads a short chapter on electricity. This chapter, however, is a disappointing one, and a writer with a real knowledge of what has been accomplished in electrical science could have given a brilliant answer to the poet's inquiry. The texts dealing with physical science are, as a rule, not so well expounded as those referring to natural history objects. The idea of viewing the sublime poem of the Book of Job from the aspect of latter-day scientific knowledge is, however, an excellent one, and we trust the book will be read by priests as well as the laity; for the contents will be found a source of inspiration to all interpreters of Holy Scripture.

*La Céramique Ancienne et Moderne.* Par E. Guignet et E. Garnier. Pp. 311. (Paris: F. Alcan, 1899.)

THE author of the second section of this work, M. Garnier, is already well known as a writer on ceramic art. Filling the important post of Keeper of the Sèvres Museum, he enjoys ample opportunities of becoming familiar with the development of earthenwares and porcelains and the characteristics of the several kinds. But a couple of hundred pages illustrated by fifty poor process-blocks have not afforded M. Garnier the chance of treating his subject adequately. The essay by M. Guignet on materials and manufacture, though far too slight and unequal in treatment, is good so far as it goes. Unfortunately, he omits much that one expected to find in his pages, *e.g.* the process and rationale of salt-glazing, while he repeats (p. 86) the exploded theory that Josiah Spode, about the year 1800, first introduced bone-ash into the body of English porcelain. Several other Continental writers on ceramics, when they give any account of English porcelain and earthenware, do not

fail to reproduce this error. But in point of fact this phosphatic porcelain, called by the French *Porcelaine tendre naturelle ou Anglaise*, dates back to the year 1748, and was made largely at Bow, and at other English china factories long before the time of Spode. Numerous chemical analyses of authentic specimens have proved this point without the shadow of a doubt. The volume would have gained greatly in scientific interest had the authors introduced plates representing the microscopic structure of the chief porcelains and wares One such plate only is given, and that is poor.

## LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### The Acoustic Analysis of the Vowels from the Phonographic Record.

Many attempts have been made to determine vowel timbre from the phonographic record, with more or less of success. The difficulties of transcription on a sufficiently large scale has proved considerable. With the aid of Dr. F. C. Van Dyck, Professor of Physics, in Rutgers College, I have succeeded in constructing an apparatus at once simple and satisfactory, and have reached results that seem worthy of consideration.

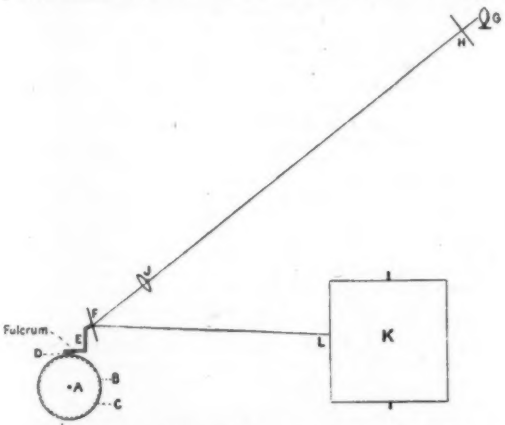



FIG. 1.—A, section of phonograph wax cylinder; B, surface of the wax; C, bottom of the furrow, with undulations much exaggerated; D, sapphire knob of tracer; E, rigid lever bearing adjustable mirror; F, adjustable plane mirror; G, source of light; H, plate with pin-hole through which light passes; J, convex lens with conjugate foci at H and L; K, revolving drum carrying bromide paper; L, surface of paper on which point of light leaves the sinuous trace.

The vowel curves obtained are large enough to be measured with precision, and the method employed allows greatly increased enlargement if desired. The apparatus I have used is illustrated diagrammatically in the accompanying figure (Fig. 1). The most essential part is simply the automatic reproducer of the Edison Phonograph from which the diaphragm is removed, and upon the tracing lever of which a rigid arm is fastened which bears an adjustable mirror. If now the sapphire knob of the tracer is made to follow a record *very slowly*, the mirror will be deflected back and forth in correspondence with the undulations of the record furrow, and by means of a narrow beam of light reflected from it, and focussed upon a strip of moving bromide paper, a sinuous photographic trace is obtained exactly corresponding to the bottom of the furrow in the wax cylinder.

It is manifest that this method of transcription makes possible a very great enlargement. In the reproducer the short arm of the lever, *i.e.* the difference between the sapphire tracing knob and the fulcrum, is about one-eighth of an inch in length. Working with a beam of light of the length of ten feet gives therefore an enlargement of about one thousand times. By making the short arm one-sixteenth of an inch and the working distance thirty feet we may without great difficulty multiply ordinates by six thousand. As yet I have not found it necessary to enlarge more than one thousand times.

Since the actual depths of the hollows made by the phonograph recorder in the wax for a good vowel tone are often as much as one two-thousandth of an inch, and are generally greater than one twenty-thousandth of an inch, an enlargement of one thousand times gives for such tones a curve of which the ordinates are easily measured with precision.

It is not possible in the space at my command here to describe the details of my apparatus or of my experiments. Those who may be interested I refer to a more extended account which will shortly appear in the German Phonetic Journal, *Die Neueren Sprachen*, and to a short description of apparatus and results in the *Physical Review*.

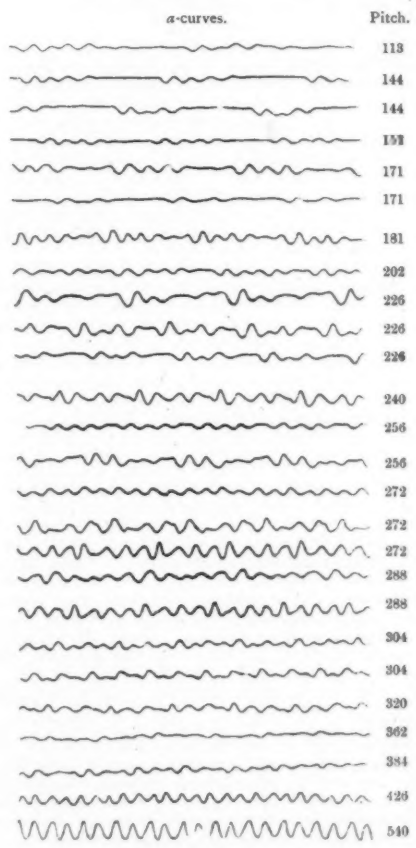



FIG. 2.

I have obtained many records of all the principal vowels of English speech, but have not yet completed work on any vowel save *a* (as in father) far enough to make even a preliminary report. The accompanying diagram gives a few specimen *a*-curves (Fig. 2). The pitch is indicated by the vibration number at the side of each wave-section. The quality of the vowel represented is the same in each case, as far as possible, at different pitches, and by different voices. The record in each case gave in phonographic reproduction a clear and unmistakable *a* (as in father). The sections shown represent about the one fifty-sixth part of a second, and the whole sheet has been reduced for convenience to about one-quarter of the actual size. The traces which I obtained and measured for analysis, by

means of the Fourier theorem, were therefore four times as large as the curves here shown.

I subjoin herewith a few specimen analyses. In the table, column I. contains the vibration number of the fundamental, *i.e.* the pitch at which the vowel was sung, and its amplitude percentage; column II. contains the vibration number of the first overtone, *i.e.* the octave of the fundamental, and its amplitude percentage, and so on.

| I | II | III | IV | V | VI | VII | VIII | IX | X | XI |
|---|---|---|---|---|---|---|---|---|---|---|
| 113 | 226 | 339 | 452 | 565 | 678 | 791 | 904 | 1017 | 1130 | 1243 |
| 9·9 | 15·4 | 2·5 | 0·8 | **11·5** | **16·1** | 3·3 | 8·1 | **21·2** | 7·2 | 3·2 |
| 144 | 288 | 432 | 576 | 720 | 864 | 1008 | 1152 | 1296 | 1440 | 1584 |
| 32·9 | 4·3 | 1·9 | 8·5 | **14·8** | 2·1 | 8·8 | **13·5** | 7·2 | 1·3 | 4·7 |
| 171 | 342 | 513 | 684 | 855 | 1026 | 1197 | 1368 | 1539 | 1710 | 1881 |
| 5·6 | 4·8 | 2·9 | **17·5** | 5·0 | **33·1** | **19·9** | 2·1 | 6·1 | 1·9 | 1·1 |
| 226 | 452 | 678 | 904 | 1130 | 1356 | 1582 | 1808 | 2034 | 2260 | 2486 |
| 9·2 | 3·6 | **34·6** | 8·0 | **31·J** | 2·6 | 6·2 | 1·4 | 0·8 | 1·2 | 1·4 |

It will be sufficient here to state as briefly as possible the conclusions which I believe to be warranted. The vowels as produced by the human organs of speech are composed in the first place of two elements, that due to the vibration of the vocal chords and that due to the resonance of the mouth, throat and nose cavities. It is not always possible to separate clearly these two elements, but at the pitches shown in the above table the problem is quite simple for the vowel *a*. The fundamental is due to the vocal chords, and the overtones that are strongly reinforced are due to the mouth and throat resonance. The vowel *a*, at any pitch, and pronounced by any clear voice, contains the following partial tones:—

(1) The fundamental, with the first two or three overtones. The fundamental varies greatly in relative amplitude for reasons which I do not as yet attempt to formulate. The overtones are all weak, unless reinforced by the mouth resonance as set forth below.

(2) The overtone or overtones whose frequencies of vibration chance to fall between 1000 and 1300 vibrations to the second, the maximum seeming to lie at about 1150. This is the main characteristic of *a*, which serves to identify it to the ear, and remains remarkably constant, no matter what the fundamental may be. If the fundamental has 144 vibrations to the second, overtones VII., VIII. and IX., with frequencies of 1008, 1152 and 1296 respectively, will all be present, but VIII., with 1152 vibrations to the second, in much the largest amplitude.

(3) The overtone or overtones whose frequencies of vibration chance to fall between 575 and 800 vibrations to the second for men's voices, with a maximum at about 675; or between 675 and 900 with a maximum at about 800, for the voices of women and children. This is presumably the resonance of mouth and throat cavities resounding as one vessel, and is not as constant as the main resonance described above. If the fundamental has 144 vibrations to the second, we shall therefore find overtones IV. and V. present, with frequencies of 576 and 720 respectively, but V., being nearer the point of maximum resonance, will be the stronger.

The two regions of resonance are indicated in the table by printing in larger figures the amplitude percentages of those overtones which fall at or near the points of maximum resonance, and are therefore present with large amplitudes. My analyses reveal for the vowel *a* no other region of resonance that is constant or important except these two. On the basis of many observations it would be possible to plot a curve which would represent the mouth resonance for the *a*-position. A tentative chart of this sort will be found in the articles already cited, and in general for a fuller discussion of the whole subject the reader is referred to those articles. LOUIS BEVIER.

Rutgers College, New Brunswick, N.J.

## Illustrations of Lepidoptera.

CAN any of your readers assist me in finding some artist who is really competent to produce, by any process which combines extreme accuracy with a reasonable cost, a large series of illustrations of variation in butterflies? The difficulty of getting such work done in the country under my own eye is very great, and I am unwilling to do as some of my friends advise, and get them made in Germany. Where the variation is a question of pattern only, photography would probably be the most satisfactory process; but where colour is the leading feature of the variation, chromo-lithography seems the most likely to succeed. The number of works on natural history which are privately published in England seems to point to a want of enterprise among English publishers which I cannot understand, as the market for really well illustrated works on ornithology, botany and entomology is certainly increasing. Any suggestions addressed to me will be gratefully received. H. J. ELWES.

Colesborne, Andoversford R.S.O., Gloucestershire.

## "Billiards Mathematically Treated."

THE review, in your issue of March 1, of Mr. Hemming's book on billiards reminds me that I have never yet seen a satisfactory explanation of the following question:—

Why does a billiard ball when struck to the right or left of its vertical axis nevertheless travel in the direction in which the cue travels?

It only does so when the cue tip is chalked, otherwise it travels in a direction of a line through the centre of the ball and the point of contact with the top of the cue, as may be expected from the laws of dynamics. The chalking of the cue of course enables the striker to put on what is known as side, *i.e.* to make the ball revolve on its vertical axis; but why does it also allow the ball to travel in a straight line instead of going off at an angle? ENQUIRER.

THE answer to "Enquirer's" puzzle is very simple. If you let a perfectly hard and smooth cue tip impinge at any angle on a perfectly hard and smooth ball, the only force exerted will be normal, and the ball will start in the line from the point of impact to the centre of the ball. At the same time, during the brief duration of the impact the cue tip will slide a minute distance along the surface of the ball, but in consequence of the perfect smoothness will exert no tangential force on the ball.

Now take the extreme case in the opposite direction. Let the cue tip be such that it bites on the ball without any sliding whatever during the impact. In this case the point of the ball struck moves exactly in the direction of the motion of the cue—the centre of gravity of the ball moves in precisely the same direction with a rotation added which is familiar to us as side—and this will be so (if the bite is perfect), whatever may be the angle between the direction of the cue and the surface of the ball. With the ivory tips in use more than a century ago, you had something approaching, though not quite reaching, perfect smoothness—and the ball flew off not quite, but very nearly, in the normal direction. With modern tips in good order and well chalked the bite is sufficient to prevent any slipping and drive the ball in the line of the cue, provided the angle between the cue and the surface of the ball is not too small; and if this condition is fulfilled the ball will start in a direction exactly parallel to the line of the cue.

If the angle is too small, as by playing side too near the edge of the ball, there will be some slip and the ball will go wrong (not quite normally, but a long way from the desired direction). It will be a miss-cue. The nearness to the edge which can be played without miss-cueing is different for different players, and depends upon some nicety in the handling of the cue which does not admit of definition.

Roberts can play side vastly nearer to the edge of the ball than I should dream of attempting, and I daresay a good deal nearer than "Enquirer" could try with success. But the broad fact is, that with a well chalked cue you can insure (within certain limits of angle) that there shall be no slip.

If the cue is not chalked you can still do the same thing within very much narrower limits, that is to say, you can put on a very little side.

The ivory tip, the chalked tip, and the unchalked tip, are three different cases intermediate between the extreme theoretical cases of perfect smoothness with unresisted slip and perfect bite with no slip at any angle however small.

I do not think that any one could have foreseen that a cue tip could be made to bite to the extent to which it does. But somebody in America or France found it out by experiment, and for the first time made billiards the scientific game which it has now become. G. W. HEMMING.

## The Micro-Organism of Faulty Rum.

IN the course of our investigations upon this organism, first alluded to by us (NATURE, vol. lvi. p. 197, June 1897), and subsequently by others (vol. lix. p. 339, February 1899), we have found that from spirit of 70 per cent. of alcohol, which has

been in our possession for three years, we can still obtain successful cultures in gelatine; the various forms, which we have previously described, have been observed as before.

Our object in sending this note is to call attention to the extraordinary vitality of this organism under such untoward circumstances, owing doubtless to its carefully entrenched position.

V. H. VELEY,
Oxford, March 10. LILIAN J. VELEY.

### Drunkenness and the Weather.

ON reading the letter of Prof. Dexter on "Assaults and Dunkenness" (p. 365), I notice that there is one great fallacy in the argument.

When a man is intoxicated and commits an assault, the result is entered in police reports as "assault," the more serious offence overshadowing the less. So that, in all probability, many of the cases of assault referred to in the statement were also cases of drunkenness, but were not tabulated as such.

The temperature is an important element; for its variations are probably the cause of the change of character of the offences recorded. The same quantity of alcohol will, as has often been noticed, have very different effects in the summer and in the winter. In hot weather alcohol has a stimulating influence; this is much less marked in the winter, and during this season the sedative effect is certainly more noticeable.

Studying Prof. Dexter's curves in this light, and assuming the absence of any other fallacies, we may reasonably conclude that the number of those arrested for drunkenness or its results varies but little throughout the year. Probably the same people supply the cases of drunkenness in winter and of assaults in summer.

R. C. T. EVANS.
9 Heathcote Street, Gray's Inn Road, W.C., March 3.

### Mechanical Methods of Calculating Logarithms.

THE following mechanical method of finding logarithms seems to be as simple as any that have been proposed, and has the advantage that it gives the logarithms of all numbers without interpolation, and at the same time affords a proof of the fundamental property of the function.

Let a flat ruler AB be provided at one end, A, with a hatchet edge (like that of the hatchet planimeter), so arranged that when the ruler is held horizontally, and the hatchet allowed to touch the paper, it touches at a point vertically below the edge of the ruler. The hatchet must lie in a vertical plane inclined at a convenient angle (say 45°) to the ruler. Let the ruler be held thus, with its edge touching a pin. On moving the ruler so that the hatchet does not slip sideways, the latter will trace a spiral curve on the paper. From its mode of generation the spiral clearly cuts all radii vectores at the same angle, and thus is the well-known equiangular spiral. Let OA be a radius vector of unit length, and OP one of length $r$. Let $AOP=\theta$ where $\theta$ may be expressed in terms of any convenient unit, then we may define the logarithm by the equation $\theta=\log r$. Of course, $\theta$ depends on the angle of the spiral and on the unit of angle adopted as well as on $r$, and so is not yet completely defined. We can, however, immediately prove the fundamental property of the logarithmic function.

Imagine a copy O'A'P' of the diagram to be made on some extensible material, and to be extended equally in all directions in the ratio R : 1. All angles remain unaltered, and the new curve is an equiangular spiral with the same angle as before. If, now, O' be placed on O, and the new diagram turned till A' lies on the old spiral, the two spirals, having the same angle, must coincide, and hence P' lies on the old spiral. Now $OA'=R$, $OP'=rR$. $AOP'=AOA'+A'OP'=AOA'+AOP$, which gives $\log rR=\log r+\log R$, the fundamental property. If we further chose our unit angle so that $\log 10=1$, the spiral will give Briggian logarithms. It would, perhaps, be more convenient practically to adjust the angle of inclination of the hatchet so that log 10 is represented by 100°, or perhaps by 360° if we divide the circle centesimally. It may seem that the logarithm, as defined above, still depends on the angle of the spiral, but this idea can be readily disproved by means of the equation $\log rR=\log r+\log R$. The logarithm, having been defined without reference to indices, may now be used to define the quantity $x^n$, where $n$ is negative or fractional, and to give the index laws in a manner rather less artificial than that usually adopted (the fact that no indication is given of the many-valued character of a fractional power is, however, a drawback).

The hatchet planimeter may be used to obtain logarithms, but in a less simple manner. If the planimeter be placed with its point on a given straight line, and its length perpendicular to the line, and the point be moved through a distance $x$ along this line, the inclination $\theta$ of the planimeter to the line is given by $x=a \log \cot \theta/2$, where $a$ is the length of the planimeter. This gives an obvious mechanical construction for a logarithm.

Leeds, March 5. H. C. POCKLINGTON.

## *THE CENTENARY OF THE BERLIN ACADEMY OF SCIENCES.*[1]

IT is with feelings of pleasure that we call the attention of our readers to the fact that rather more than one month ago the Academy of Sciences at Berlin, at its meeting on the 25th of January, commemorated with great rejoicing and some very pardonable pride the work which its members have done in the world during the last hundred years. The subjects which have been investigated by this distinguished body include almost every branch of human knowledge, and although at this date we are too near in point of time to be able to judge definitely and finally as to the value of the work which the German scholars and men of science, whose names are written on its books, have done, there is no room for doubting that they have enlarged the bounds of human knowledge in every direction, and have brought us many degrees nearer to the goal sought by all honest investigators.

The Berlin Academy has kept in mind what the true functions of an Academy of Sciences should be, for it has not sought to limit the number of subjects which its members desired to investigate, and it has not attempted to patronise or to foster the growth of one class of sciences, or of one branch of learning, to the exclusion of all others. It has encouraged knowledge of every kind, and has supported by its influence and money the workers in the most recondite branches of human learning, and its influence for good has been so far-reaching that it would need a volume if we attempted to describe the work which has been well and efficiently performed under its auspices. And the Academy of Sciences at Berlin has not only helped the world positively, as it may be termed, that is to say, by enabling its members to formulate and build up sciences, but negatively, by making it impossible for the faddist, and crank, and charlatan to press his views upon the non-expert, but well-educated, section of the German public. In this last capacity it has performed, very quietly and unobtrusively, but effectively, a most important duty, and it has succeeded in obtaining and holding a position of *authority* which cannot be gainsaid. It has proved to all the world that when it sets its seal of approval on a man's methods or works, those methods and works have permanent value. We may almost say that the work of German scholars and thinkers is so good because they possess in their country a high authority for the approval of which they are content to toil long and arduously, knowing well that its stamp is a hall-mark which the intellectual world will honour, and the full value of which will be duly credited to it. Of the universality of learning the Academy at Berlin has been a consistent and powerful patron, and the long list of great names which Herr Waldeyer, one of the secretaries of the Physical Section, brought to the notice of the members at its festival meeting is a splendid proof of this statement. Among historical investigators and jurists may be mentioned Fichte, Schleiermacher, Schelling and Trendellenburg; among students of linguistics and archæologists, Boeckh, Bekker, Bopp, Curtius,

[1] *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin. 25 Januar. Öffentliche Sitzung zur Feier des Geburtsfestes Sr. Majestät des Kaisers und Königs und des Jahrestages König Friedrich's II.* In Commission bei Georg Reimer, Berlin.

Haupt, Dillmann, Müllenhoff and Lepsius; among mathematicians and physicists, Dirichlet, Kronecker, Erman, Dove, Kirchhoff, Kundt and Helmholtz; among chemists, Mitscherlich and Hofmann; among astronomers, Bode, Ideler, Encke; among geographers and cartographers, Ritter and Kiepert; and among biologists, Link, Braun, Lichtenstein, Ehrenberg, Müller and du Bois-Raymond. The above names represent only a selection, but these eminent members by their works have permanently influenced, and have stamped their individualities upon, the various sciences to the investigation of which they devoted their best powers and their lives. The Berlin Academy, and the very few institutions which resemble it, are the only places where men of such diverse qualifications and acquirements as Schleiermacher, Ranke, Lepsius, Dillmann, Seebeck, Kirchhoff, Helmholtz, Hofmann and Encke could be found sitting together as members and discussing the best methods for furthering the universality of knowledge. In Berlin, Vienna and St. Petersburg the past and present members of the Academies have carried out the intentions of their founders, and every branch of human knowledge has been considered worthy of recognition and encouragement at their hands.

The Academy at Paris was originally founded for the preservation of the French language, but the French savants soon found that it was necessary to establish other bodies which should represent the arts, and sciences, and archæology. Hence the Académie des Inscriptions, the Académie des Sciences, and the Académie des Beaux Arts came into being; in 1795 these Royal Academies were combined under the general title of Institut National. Thus together they represent all natural knowledge, and the various Academies really form sections of one great controlling and directing intellectual power in France. The operations of this power are so extensive that even a writer like M. Zola thinks himself entitled to enrolment among the members of one of its great sections.

When Herr Waldeyer had read his festival address he proceeded to report to the meeting what works the Academy had in hand, and to describe the progress which had been achieved in them. These included a *Corpus* of Greek inscriptions under the direction of Kirchhoff, a *Corpus* of Latin inscriptions under the direction of HH. Mommsen and Hirschfeld, the publication of the Commentaries on Aristotle, of the political correspondence of Frederick the Great, of the *Acta Berussica*, of the Latin Thesaurus by Diels, of an edition of the works of Weierstrass, of the work of Kant, of the Arabic history of Ibn Saad, of an Egyptian Dictionary, &c.; to give a list of all the works upon which the Academy is engaged would exhaust our space, and the curious reader will find them all mentioned on p. 45 ff. of the *Sitzungsberichte*.

The writing of these remarks causes many disquieting facts to cross the mind; foremost among them is that which tells us that there is no equivalent in England of the Academy of Sciences at Berlin. In its earlier years the Royal Society in a measure occupied in England the position now held by the Academy at Berlin in Germany, but such is no longer the case. The founders of the Royal Society apparently intended its members to be recruited from the ranks of scientific men of every kind, and the first seventy volumes of the *Philosophical Transactions* bear testimony to the truth of this assertion. The pages of that work were open to every scholar and man of science, provided that he had something to say and knew how to say it, and as a result the earlier volumes of the *Philosophical Transactions* are wider in their scope than the later ones.

Thus if the reader will take the trouble to turn over their pages, he will find papers on Latin, Greek, French, Irish, Phœnician, Etruscan and Runic inscriptions; accounts of pigs of lead, a tesselated pavement, a leaden coffin, Irish urns, &c.; an extract from a letter comparing the Egyptian and Chinese languages, and even a paper "On judging of the age of learned authors by style." Mr. P. H. Maty's Index of the first seventy volumes of the *Philosophical Transactions*, published in 1787, will supply many other examples of the extreme comprehensiveness of the scope and view of the Royal Society in its earlier years.

Slowly but surely the view of the Society has narrowed itself, and almost the only welcome guests are the mathematician, and physicist, and biologist; in like manner the *Philosophical Transactions* and *Proceedings* have become the home of "papers" in which letterpress and figures and algebraic signs appear in almost equal proportions. Papers on philology and archæology are extremely few, whilst those on physics and physiology greatly preponderate. Is it too late for the Royal Society to come back to the original field of its investigations? And although everything "made in Germany" is not necessarily good, it would probably gain more power and increase its influence if it imitated the excellent example afforded by the Academy of Sciences at Berlin in its efforts to further the universality of knowledge.

## *THE POTENCY AND PREPOTENCY OF POLLEN.*

IN his book on "Cross and Self-fertilisation of Plants" (pp. 393-401), Charles Darwin called special attention to the subject of pollen-prepotency, and showed that numerous cases occur where the ovary of a given flower is more effectually pollinated by means of pollen-grains from some other flower, or from particular anthers, than by grains from its own anthers. If the two kinds of grains be present together on the stigma, the prepotent pollen is able to drive its tubes down the stigma more rapidly than the other, and so the ovules are reached first, and the egg-cells fertilised by the contents of the favoured or successful tubes—a point of great significance in crossing. Numerous examples were also given by Darwin, which indicate far-reaching effects of pollen on various parts of the flower and ripening fruit; these may be termed pollen-potency. Since Darwin's time we have learnt much more of the processes which go on in pollination and fertilisation, and, among other things, that the pollen tube of, for instance, a lily, carries down in its end, floating in its protoplasm, two active nuclei (generative nuclei) which bear in themselves the hereditable properties of the parent plant of the pollen, as well as remains of another nucleus (vegetative nucleus) of no use in fertilisation.

No fact in the domain of plant histology is better established than that fertilisation consists in the union of one of these generative nuclei with the nucleus of the egg-cell in the embryo-sac, and the researches of Strasburger, Guignard, Farmer and others have rendered the whole process of this nuclear fusion and its consequences so clear, that even minute details can be correlated with what occurs in organisms other than the flowering plants. In this connection I need only recall the demonstration by Ikeno and Irase,[1] and by Webber,[2] that the generative nucleus in the pollen tube is a spermatozoid, and in *Gingko* and some other gymnosperms is even ciliated and motile, and escapes as a true spermatozoid. This important discovery has lately been extended by Nawaschin,[3] who found that the two generative nuclei in the pollen tube of *Fritillaria* and *Lilium* are elongated, and are emptied into the embryo-sac as writhing worm-like bodies, and the same has been demonstrated by Guignard[4] for *Lilium Martagon*. The main point was also demonstrated by Miss Sargent at the last meeting of the British Association at Dover (September 1899).[5]

[1] Hirase, *Bot. Cent.* 1897, p. 34. [3] *Bot. Centralb.* 1899, B. 77, p. 62.
[2] Webber, *Bot. Gaz.* 1897, p. 16. [4] *Rev. Gén. de Bot.* 1899, vol. ii. p. 123.
[5] *Proc. R. S.* vol. lxv. 1899, p. 163.

But Nawaschin and Guignard have further shown that, in addition to the normal fertilisation of the *egg-cell* by one of these pollen-nuclei (spermatozoid), the other spermatozoid fuses with the *upper polar nucleus* of the embryo-sac, and thus brings about a sort of secondary fertilisation—a fertilisation of the cell which, by further division, produces the endosperm. For it will be remembered that the secondary nucleus arises by the fusion of the two polar nuclei.

Divested of details, while one spermatozoid nucleus carries material from the pollen into the *egg-cell*, and so transfers the influence of the male to the egg and its resulting *embryo-plant*, the other spermatozoid carries a similar share of material from the pollen into the *polar nucleus*, and thus transfers the influence of the male to the *secondary nucleus of the embryo-sac*, and thus to the *endosperm*.

Now the endosperm is regarded as the representative of the prothallus of the higher Cryptogams, and acts as the nurse for the embryo; and the upshot of the foregoing is that not only is the embryo (and through it the future plant) affected by the male hereditary substance, which can be easily seen eventually in cross-bred plants and hybrids of all sorts, but the rudimentary prothallus generation also receives its dose of male substance, and the question arises whether the effect of this dose can be traced in any visible way.

Let us now turn to another set of events. It has been known for some time that different varieties or races of the maize or "Indian corn," although all belonging to the same species, show remarkable differences, not only in the size, shape, colour, &c., of their well-known grains, but also in the nature of their nutritious contents—*i.e.* what is usually termed the "flour" or "meal." Now, this "flour" is the endosperm, and contains the nutritious substances for the growing embryo. In the typical case its cells are crammed with starch grains, well known in domestic economy as "corn-flour." But in certain races of maize there are no (or very few and small) starch grains, but a slimy substance (dextrin?), mixed with sugar, fills the cells. Again, the outermost layer of cells bounding the endosperm—the so-called *aleurone layer*—has, not starch grains, but nitrogenous reserve stores for its principal contents, and in some races bright purple or other colouring material as well, which shines through the skin of the grain (testa and pericarp), and so gives the hue to the fruit.

The economical importance of the maize[1] has stimulated many observers to experiment in hybridising the existing races, and the principal object of this article is to show how some recently observed results in this connection have—quite unexpectedly—come to cast new lights on the phenomena above referred to, and to illustrate the potency of pollen in a way not hitherto suspected.

These researches are due to De Vries,[2] and to Correns,[3] who have found that if cross-breeding is carried on between races of maize with a starchy yellow endosperm and violet aleurone layer, and races with a sugary hyaline endosperm and colourless aleurone layer, for instance, very marked effects of the pollen can be traced *in the endosperm of the directly resulting grain*, quite apart from the effects eventually discernible in the resulting cross-bred plant to which the embryo gives rise, and which, of course, are only visible in the succeeding crop. These visible effects of the pollen are expressed only in the colour and chemical contents of the endosperm.

[1] The meal is used for Polenta, corn-flower, pop-corn, &c., and after the manner of malt in distilling spirits. The young grains are cooked. The sugary sap is used for fermented drinks, Chica, Pulque de Mahiz, &c. The straw for paper, &c. The raw grain, young shoots, &c., for fodder. Some races are of horticultural value, and so on. In 1893, 32,000,000 cwts. were imported into this country (see "Official Guide to the Museums of Economic Botany, Kew." No. 2, 1895, p. 64).

[2] *Comptes rendus*, 4/12/99, No. 23, vol. cxxix. p. 973.

[3] *Ber. d. d. Bot. Ges.* 1899, vol. xvii. p. 410.

Thus, the result of pollinating a race (A) which has a colourless aleurone layer, by a race (B) with a coloured one, may be that the ripening grain of A now obtains an endosperm with its aleurone layer the same colour as B; or if A has a starchy endosperm and B a slimy and sugary one, the endosperm of A becomes slimy and sugary, and so on.

The effect of the pollen of B, so directly expressed in the resulting endosperm of A, does not necessarily show itself in the converse case, however; and if the pollen of B alters the colour of the aleurone layer in the grain of A, the effect of the reciprocal cross may be that the pollen of A alters—not the colour of the aleurone, but—the contents of the endosperm of B, *e.g.* from starchy to sugary, and so on.

Correns points out that no visible change in the embryo, or in the size of the endosperm, or size and shape of the grain can be thus directly produced—whatever may be the more distant effects visible in the cross-breed resulting from the sowing of the grain next year.

There seem to be two possible ways of explaining these remarkable phenomena.

First, we may suppose that the spermatozoid nucleus of the pollen tube, having fused with the egg-cell, so alters the embryo that as it grows it affects the endosperm (*e.g.* by secreting some enzyme) and so alters the colour of the aleurone layer on the nature of the cell-contents; this hypothesis is supported in part by the fact that while it is easy to produce sugary endosperms in grains of races which normally develop starchy ones, the converse action is not obtained.

The second hypothesis is that we have in these phenomena the direct visible effects of the fusion of the second pollen tube nucleus (spermatozoid) with the polar nuclei (from which the endosperm results). In other words, we have here a *hybrid endosperm* as well as a *hybrid embryo*.

Both De Vries and Correns regard the latter explanation as the right one, and Correns points out that similar cases have been observed by Giltay in rye.

On the other hand, no visible results in the endosperm were obtained in peas and lilies, and the deep blue colour of the yellow seeds of species of *Leucojum* or of *Peas* crossed with the pollen of deep blue seeded races of the same in each case depends on the formation of blue proteid grains in the epidermis of the cotyledons.

That these positive results will lead to renewed investigations of other cases of nuclear fusion—*e.g.* graft-hybrids and other examples of the reactions between scion and stock—may be confidently predicted, and interesting discoveries must await us. My present object is to call attention also to this excellent example of the reciprocal advantages botanical science obtains by the co-operation of workers in two totally different fields—the results from the laboratory here throwing suggestive lights on those from the seed-bed and garden, and *vice versa*. (See, also, Address to Botanical Section of British Association, Toronto, 1897, p. 3.)

H. MARSHALL WARD.

## *ATMOSPHERIC ELECTRICITY AND DISEASE.*

LAST summer I had the honour of making the acquaintance of Dr. Schliep, of Baden-Baden. He is well known to English medical specialists. He urged me to design a recording electrometer, such as would enable medical men to study atmospheric electricity. I found that he himself had made daily observations for twenty years, using a gold-leaf electroscope, which enabled him to say whether the air had strong or weak, positive or negative, electric potential, at the end of a

water-dropping collector. He showed me that he had made an earnest study of the connection between atmospheric electricity and diseases, and I am convinced that his conclusions are of great importance. I feel, therefore, that I am doing a service in bringing before the notice of readers of NATURE the following account of a paper, by Dr. Schliep, in *Sonderabdruck aus Deutsche Medizinal-Zeitung*.

He first refers to the meteorological observations usually made, and goes on to say that our knowledge of atmospheric electricity is now as vague as was the knowledge of warmth before thermometric observation became systematic. Dove, in 1837, and Humboldt, in his *Cosmos*, mention the importance of the study of atmospheric electricity. Dr. Graves, of Dublin, made observations and said: "Practically these experiments are of importance, because some causes of the periodicity of certain acute diseases, their decrease and increase at certain hours of the day, may be deduced from them." Hufeland also refers to this matter. Dr. Buzorine, of Würtemburg, in 1841, drew attention to the fact that during the cholera epidemics of the third decade of this century, there was a prevalence of negative electrification of the atmosphere. Dr. Pallas, a French physician, wrote on this subject in 1847, and Dr. Craig, an Englishman, wrote about it in 1859.

Dr. Schliep now describes his method of observation with the gold-leaf electroscope, and gives the following results. The first part of these may be said to be well known to us. What seems to me of most importance is the effect on organisms.

Atmospheric electricity is generally positive. If the sky is covered, the potential decreases or shows variations, and is from time to time negative. During rain, negative potential is often observed. The approach of a thunderstorm is generally marked by great alteration towards the negative, followed by considerable oscillations in both directions, with a predominance of negative. Usually the positive potential is higher and more regular during the night than during the daytime. From 9 p.m. to 3 a.m. the potential changes little. It diminishes by daybreak, reaches its lowest value at 3 p.m., then increases and reaches the maximum at 9 p.m. There is, therefore, a minimum during the day, and an almost constant maximum during the greater part of the night; that is to say, there is only one daily period. These facts are deduced from the use of the registering apparatus of Mascart. Other observers have found two maxima and two minima, but they are probably only accidental variations. In every month there are a number of days on which negative electrification can be observed, others, and they are rare, when there is scarcely any electrification noticeable. On most days there is positive potential.

According to Marié Davy's observations in Paris, and Dr. Schliep's at Baden, there are two days of positive electrification for 28 negative. The winter shows higher potential than the summer.

Many terrestrial phenomena, such as earthquakes, are said by trustworthy observers (Schubler, Humboldt) to greatly influence atmospheric electricity. After an auroral display there is strong positive electrification. At greater elevations, especially on steep and high mountains, the electrification is greater.

Dr. Schliep makes the following statements about the influence of atmospheric electricity on human beings:—Negative electrification is tiring, positive is exciting. Positive is favourable to the process of oxidation, increases metabolism, circulation and secretion. It may be that the increased formation of ozone has an influence in this way also, but we can imagine a direct stimulating influence of positive electricity on the nervous system. We may affirm the existence of this influence as, during strong electrification, disturbances of the normal condition are noticeable, as in sleeplessness, the existence of states of anxiety, hysteria, neuralgia, and even sometimes inflammation of the respiratory organs. One interesting confirmation of this opinion is found in the observations which Eyselein has made regarding the behaviour of nervous people, as influenced by the amount of ozone in the air. It seems that if there is too little ozone, and especially if it completely and suddenly disappears, there is considerable bodily disturbance; whilst its sudden reappearance causes a quick return of healthy feeling. It has also been proved that a continuance of much ozone is not unfavourable to health. Ozone intensity less than No. 10 of Zender's scale, but not much less, has a tonic effect on nervous people, but intensities from 9 to 4 cause disturbances. These facts agree with the observations I have made in regard to the health of my patients, as affected by atmospheric electricity. From these observations I conclude that a certain amount of nervous disorder, as well as a power of resistance, are associated with positive electrification. As in many other cases, there is therefore in this instance the possibility of having too much of a good thing.

Unhealthy symptoms, unfavourable to tissue-change, accompany negative electrification. Feelings of fatigue and lassitude, exhaustion of the nervous system, arrest of perspiration, loss of tone in the blood-vessels, accompany negative electrification. Congestion, bilious and apoplectic attacks and hæmorrhages are the results The development of bad gas, processes of decomposition, and increase of bacilli are the accompanying phenomena. Certain forms of disease, as angina, pneumonia, herpes, may, to extents depending upon local conditions, increase with negative electricity, and seem to be related to the souring of milk, the decomposition of meat, and the development of bad smells in the street gutters and drains. If we say that the bacilli are the cause of these things, it may be true; but it does not explain why bacilli find more favourable conditions for their existence on some days than on others with equal warmth, moisture, air-pressure, &c. Dr. Schliep goes on to say that we get clearer notions if we consider the difference between animal and plant metabolism.

We know the astonishing effect of a close thunderstorm-day on vegetation, the sudden breaking forth of buds, leaves and flowers, the quick development of the young seed, and the sometimes rapid growth of such plants as asparagus. Light, warmth and moisture are of course the first conditions. The observation of this remarkable phenomenon gave rise to an interesting experiment of Becquerel. He selected four hyacinth roots of equal size and sort, which he put in a weak salt solution, two in a frame of glass, the third in a frame of zinc, and the fourth in a frame of copper. The copper and zinc were attached to each other by a wire. The vegetation developed most at the negative pole, less in the neutral frame, and was least at the positive pole. It seems that the roots of plants need a negative electric medium, and the crust of the earth is constantly negative. What increases the tissue-change in plants, decreases that of the animal organism. Thus, very often, days good for vegetation become tiresome for us. Walking in the streets causes great fatigue. All animals are tired on these days. They are the days of negative atmospheric electricity, days on which the bacilli are triumphant; wounds become septic, and germs of epidemic diseases find favourable conditions for development. It will concern bacteriology to pay attention to the facts. In balneo-meteorology, the most important object is the influence of atmospheric electricity on the anomalies of the constitution. From its better study we shall be able to derive hypotheses for our hygienic and therapeutic study, and besides the importance of geographical position, warmth, moisture, &c., atmospheric electricity will also play an important part in the classification of climates. We shall not only have to distinguish between land and sea-

climates, wet and dry climates, cold and warm climates, but we shall also have to characterise a climate by its electrification and define with greater exactness the terms "relaxing" and "bracing."

Perhaps we shall also be able to speak of a "spending" and a "saving" climate. We must not separate one characteristic of the climate from another and prefer it; in nature all phenomena work more or less together, they depend on one another and exercise mutual influences on one another. The electric conditions of the air are indicated by other meteorologic records, and hence we have important sources of information which ought not to be neglected, as our methods of making direct electric observations are not yet satisfactory. One can, from the daily increase or diminution of pressure, warmth and moisture of the air, say something of its electrification.

In this connection it is of no importance whether the barometer is high or low, but whether it rises or falls. It is not important to know whether the moisture of the air is great or not; it is important to know whether the moisture decreases or increases, whether the process of condensation or of evaporation prevails.

Dr. Schliep here described at length the meaning of dew-point in hygrometric observations. He exhibited also a reduction disc made by Lambrecht, of Göttingen, a sort of circular slide rule, to facilitate the reduction of observations. He showed that the atmospheric electrification becomes negative if the average temperature and dew-point rise and if the barometer falls at the same time. If, however, the temperature and dew-point fall whilst the barometer rises, one may assume a positive electrification. He pointed out on the curves which represent his registrations at Baden during the previous ten years, that the air-pressure on one hand, and the temperature and moisture on the other, altered mostly in opposite directions. It was noticeable also that an exceptional steadiness for a few days was accompanied by the reverse of these movements as soon as the lines went far asunder. The graphic representations of meteorological phenomena show more than one would think at first sight. More plainly than lists of numbers, they allow a comparison of climatic conditions of different years or of certain periods with the statistics of the prevalent diseases during those periods.

Without a good graphic representation such statistics are never complete, however valuable the material which has been collected may be. Thus, for example, consider the work of Hippius, published in the *Archives for Clin. Medic.* vol. xl., about dysentery and meteorological influences upon it, in which there was an inquiry about the relation between meteorological changes and bleedings of the lungs with no apparent result. May not the failure of this inquiry be due to the fact that the meteorologic information was incomplete?

Dr. Schliep finishes his paper by pointing out the importance of the general meteorological observations at watering-places being under a central governmental control. The health resorts ought not to rest until they have obtained this aid from Government. But he distinguishes general meteorology from the simple kind of observation which it is in the power, and ought to be the duty, of every medical man to make for himself.

JOHN PERRY.

## *PROFESSOR ÉMILE BLANCHARD.*

BY the death on February 11, at the ripe age of 84 years, of Prof. Émile Blanchard, France has lost the *doyen* of its zoologists, the French Academy one of its oldest and most esteemed members, and the Paris Museum a famous entomologist. Blanchard's career was a somewhat remarkable one, and at the same time a noble example to others; for he rose to distinction from the ranks, and, when stricken by one of the most terrible of all afflictions, never swerved for an instant from the course he had to run.

Entering, at the age of fourteen, the department of entomology of the Paris Museum, in the humble capacity of what would be termed an "attendant" in our own Museum, Blanchard soon developed such a capacity for zoological work that he was transferred to the scientific staff. His first great chance of distinguishing himself occurred when he accompanied, in 1844, Prof. H. Milne-Edwards on his celebrated expedition in the *Santa Rosalia* to Sicily, for the purpose of studying the marine fauna of the coasts. Shortly after this he was appointed Professor of Entomology to the Museum; and in 1862 received the honour of election to the French Academy of Sciences. Throughout life his chief study was entomology, the Coleoptera being his especial favourites; but he also devoted a considerable amount of attention to other branches of zoology, as well as to comparative anatomy, and in his latter years entered on the study of the geographical distribution of animals, both in past and present times. His works on Madagascar and New Zealand are well-known examples of his devotion to the latter branch of science. As a token of the esteem in which his labours were held by his fellow-workers, it may be mentioned that a genus of Carboniferous Neuroptera was named *Blanchardia* in his honour; while several of the fossil birds from the Miocene of France described by Milne-Edwards, such as *Anas blanchardi* and *Palaeortyx blanchardi*, received their specific titles after the subject of this notice. In addition to purely scientific memoirs (of which a long roll stands against his name) Prof. Blanchard was a frequent and admired contributor to the *Revue des Deux Mondes* on general subjects.

But the most remarkable circumstance connected with a large portion of his work yet remains to be told. In early life Blanchard was gifted with extraordinary acuteness of vision, and was thus enabled to make dissections of extreme delicacy (of which he has left numerous drawings and sketches) without the aid of lenses. In fact, his eyes were described by one of his early contemporaries as veritable microscopes. At the age of forty his visual powers showed serious signs of weakening. Year by year the failure of power increased, with the result that at 45 he became nearly, and at 50 totally blind. In the words of Professor Gaudry, "What more frightful affliction could have befallen a man whose life was passed in the investigation of Nature's secrets? The existence of a naturalist, who seemed specially favoured by his natural gifts and by the honours received at an age when they are obtained by few, was delivered over to the misery of darkness. If only Blanchard could have still enjoyed the delights of family life, if, while unable to see them, he could have listened to the voices of a devoted wife and beloved children! But all was gone; he no longer saw, no longer heard anything! The visits of a few friends could alone, from time to time, afford solace to his lonely existence."

Amid the unfeigned sorrow of his *confrères*, his remains, on February 14, were consigned to their last resting place.

Perhaps his best-known works are "Histoire des Insectes," 1845; "Catalogue des Coléoptères du Museum d'Histoire Naturelle de Paris," 1850; and "Metamorphoses des Insectes," 1868. R. L.

## *DRS. C. T. R. LUTHER AND G. RÜMKER.*

WITHIN a few weeks, two observatories which have played a worthy part in the past history of astronomy have, by the death of their respective directors, suffered a notable loss, and science will deplore the removal of two well-known names from the roll of worthies, who are remembered with gratitude for much indefatigable, if not brilliant, work.

For forty-eight years Dr. Carl Theodor Robert Luther worked unremittingly with the small instruments of the Düsseldorf Observatory, and few men have won so much satisfaction and rendered such essential services with apparently inadequate means. When, a half century ago, he began to direct the fortunes of the little Observatory of Bilk, the discovery and the observation of small planets still awakened considerable interest in the astronomical world, and he perceived that a small observatory, somewhat meanly equipped, could not undertake a more meritorious service than to devote itself methodically to the study of the movement of these bodies. Resolved to devote himself to this work, he never swerved from it. How well he worked with a six foot equatorial and a simple ring micrometer will readily be admitted by those who have had to use his observations in the discussion of planetary orbits. In this one subject, which he had made his own, his untiring devotion enabled him to compete in accuracy, and in quantity of observations, with other observatories possessing greater optical power and employing more delicate apparatus. He lived to see the branch of astronomical science that he loved and supported become somewhat discredited by the very wealth of material with which the possessors of larger optical means and improved star-charts were able to startle and to overwhelm plodding computers and observers. If observation did outrun computation, Luther, however, made some effort to withstand the onrush, and he succeeded in placing the theory of five of the planets—Hebe, Parthenope, Melete, Danae and Glauke—in such a satisfactory position that they are not likely to be lost.

But Luther's work began long before he went to Bilk. He was attached to the staff of the Berlin Observatory before Neptune was discovered. He took a share in the construction of the Berlin star-charts, that rendered the actual detection of the planet so simple; and every one who has used Olbers' method for computing comet orbits will recall with satisfaction Barker's Table of Parabolic Anomalies, "von neuem berechnet von Herrn Stud. Luther."

Modest honours followed Luther in his simple-minded devotion to astronomy. In 1854, he was elected a Foreign Associate of the Royal Astronomical Society, and in the following year the Bonn University elected him a Doctor of Philosophy. Seven times did the Paris Academy vote him the Lalande Prize for his discoveries, and when the same Academy struck a medal to commemorate the completion of the first hundred small planets, his portrait appeared on the medal side by side with those of Hind and Goldschmidt, the representatives of Germany, England and France in this special field of research.

The death of Dr. George Rümker, Emeritus Director of the Hamburg Observatory, is also announced—a name long and honourably connected with the Hamburg Observatory, and associated with much good work. The late director was born at the Observatory, where his father, after his return from Paramatta, was in residence. Early trained to astronomical methods, Dr. George Rümker had the advantage of experience in various observatories, spending some time at the Durham Observatory under the late Prof. Chevallier. On his return to Germany he was attached to the Hamburg Observatory, and busied himself with the preparation of a catalogue of circumpolar nebulæ. After his appointment as director, the energies of the observatory have been mainly devoted to the observation of planets and comets. These observations, which have been mainly published in the *Astronomische Nachrichten*, display a considerable amount of activity; but in addition to researches of a purely astronomical character, Dr. Rümker had given very considerable attention to all questions connected with the improvement of navigation, and to the testing of instruments required in the service of the marine. The rapid development of the Port of Hamburg has made the testing of chronometers and accurate time distribution matters of prime importance, and the late director fully recognised the desirability of ministering to the necessities of the port.

## *DR. THOMAS PRESTON, F.R.S.*

WITH sincere regret we announce the death of Prof. Thomas Preston, which occurred at his residence in Dublin on March 7. Still a young man, the event, although preceded by a tedious illness, came as a shock to his friends, and we believe will be learned with sorrow by every scientific man in this country. Abroad, too, his name had recently become well-known in connection with his researches on radiation in the magnetic field.

Thomas Preston was born in co. Armagh in 1860. He graduated both in the Royal University and in Trinity College, Dublin, in each University gaining high distinction in mathematics and experimental science. The first edition of his well-known "Theory of Light" appeared in 1890; his "Theory of Heat" in 1895. He filled the post of Science and Art Inspector for Ireland since 1894. He held a Fellowship in the Royal University, and also the degree of Doctor of Science of that University; and was elected a Fellow of the Royal Society in 1898.

What great promise was in Thomas Preston is known to all who are acquainted with the good scientific work he had already accomplished. The Royal Dublin Society recently conferred upon him the Boyle Medal for distinguished work in the domain of pure science. On that occasion the Science Committee of the Society reported on his work in terms a quotation from which will best serve to convey in a brief notice the scope of Preston's contributions to science. The report more especially relates to his services in connection with radiation in a strong magnetic field, and summarises the part he took in this recent branch of research, as follows:—

"Early in 1897 the broadening of the spectral lines arising from radiation in a strong magnetic field was announced by Dr. P. Zeeman; and about the middle of that year, Dr. Zeeman further announced the fact that the triple nature of some of these lines had been established by aid of the differing polarisation of the central and lateral bands. This important experimental work was the first completely successful accomplishment of an experiment undertaken by Faraday, so long ago as 1862. The theoretical aspect of Zeeman's first experiments had been examined by Prof. Lorentz and by Dr. Larmor. The threefold nature of the broadened lines as well as their polarisation phenomena had been predicted by these mathematicians, and also the probability that the change of wave-length introduced by the magnetic force should be proportional to the square of the wave-length of the affected lines.

"Such, briefly, was the state of the inquiry, when Prof. Preston—working with the Rowland Grating of the Royal University—brought his first research before this Society towards the close of 1897. ('Radiation Phenomena in a Strong Magnetic Field,' *Trans.* R.D.S. vol. vi. Ser. ii. p. 358).

"Members of this Society who were present on that occasion will recollect that they were treated to no second-hand account of the phenomena, but were shown—a feat not before attempted—the triplication and quadruplication of the lines of cadmium and zinc, by means of photographs projected on the screen.

"In this communication, Prof. Preston not only showed that he had attained a higher degree of resolution of the lines than had up to this been accomplished, but he was able to announce the existence of quartet and sextet forms for the first time. In his paper he seeks for explanation of the quartet variation from the normal triplet, and the fact that the difference of wave-length introduced by the magnetic force is not proportional generally to the square of the wave-length (as the simple theory seemed to suggest) was forced upon him at this early stage of his work.

"Although these matters were laid before the Royal Dublin Society in December 1897, Prof. Preston can lay still earlier claim to these observations, as appears from a short communica-

tion to NATURE in November of the same year. (NATURE, vol. lvii. p. 173).

"The second memoir on the subject appeared in the *Transactions* of the Royal Dublin Society for June 1899 (vol. iii. Ser. ii. pp. 7 *et seq.*), having been read by Prof. Preston in June of that year.

"He here offers an explanation of the quartet form analogous to Prof. FitzGerald's suggestion that the ionic orbits will vibrate with definite period about their position of rest in the magnetic field, and records the observation that, for corresponding lines of the natural groups or series of Kayser and Runge, the theoretic condition obtains.

"He further, in this communication, suggests a law which apparently involves the far-reaching conclusion that structural features in common are possessed by chemically related atoms. Although such a conclusion commends itself for other well-known reasons, so direct a proof as is involved in 'Preston's Law' had hardly been hitherto adduced. This law he illustrates by the case of three substances:—magnesium, cadmium and zinc. The law expresses the fact that not only are similar lines in the series of chemically related elements similarly modified by the magnetic field, but that the value

$$\frac{d\lambda}{\lambda^2}$$

is, in these cases, the same. The importance of this law, whether the theory of ions is accepted or not, is accentuated in M. Cotton's able review of the present state of the investigation. (Le Phénomène de Zeeman, *Scientia*, October 1899.)

"In the course of these researches Prof. Preston was gradually increasing the strength of his magnetic field, and lately was using a magnet built to his own design attaining a field of 40,000 C.G.S. units. The design of this magnet is original, but a published account of it has not yet appeared.

"With the aid of this powerful instrument he was able to announce, in the addendum to his paper in the *Trans.* R.D.S. last referred to, that the quartet form hitherto noticed is really a sextet, the outer lines being feebly bipartate, that the normal triplets are not further resolved, and that the diffuse triplets are, in fact, nonets, consisting of unequally luminous lines.

"Contemporaneously with these papers, others, mainly recapitulatory, appeared in the *Philosophical Magazine* and in NATURE.

"A clear and lucid account of the whole matter is also to be found in the report of Prof. Preston's lecture before the Royal Institution, appearing in NATURE (vol. lx. June 22, 1899).

"It is satisfactory to find how clearly in his later papers Prof. Preston recognises the pioneer work of Dr. G. J. Stoney (upon whom this Society conferred the Boyle Medal last year).

"We have in the foregoing referred to Prof. Preston's leading work and to that specially qualifying him to receive the Boyle Medal, but before this work appeared, he was already known as a writer on science of high standing. His text-books on Light and Heat are at once characterised by a clear and pleasant style and a thorough grasp of the subjects treated. These works may each fairly claim to be advances on any previous English text-books of the same scope.

"Prof. Preston is also the author, in part, of a well-known text-book on 'Spherical Trigonometry,' as well as of several scientific papers, which are all marked by his ingenuity and thoroughness."

All who have known Thomas Preston will share in a feeling more deeply founded in human nature than the regret for his "unfulfilled renown"—regretful as this assuredly is. The loss of his friendship will be felt even more keenly than the strong sense of the great loss science has experienced by his early death.

## *GEORGE JAMES SYMONS, F.R.S.*

SCIENCE in general, and Meteorology in particular, has lost an ardent worker by the death of Mr. G. J. Symons, F.R.S., the indefatigable founder of the British Rainfall Organisation. He had been enjoying good health until the evening of February 14, when he was stricken with paralysis, from which he never rallied, but passed peacefully away on the afternoon of Saturday last, March 10.

George James Symons was born at Pimlico on August 6, 1838. While quite a lad he became interested in natural phenomena, and very early commenced regular weather observations. His love of this became so strong that his parents were ultimately obliged to permit him to follow this branch of science, although he was warned by such a high authority as Mr. James Glaisher, F.R.S., that "science would not pay." He served under Admiral FitzRoy in the Meteorological Department of the Board of Trade for a few years, and then began his life-work of collecting rainfall statistics. His first annual volume of "British Rainfall" was for the year 1860, and this contained records from 168 stations. How this work grew under his guidance and ceaseless energy is seen from the fact that in the volume for 1871 he published records from 1504 stations; for 1881, from 2145 stations; for 1891, from 2799 stations; while for 1898 he was able to publish records from 3404 stations. The information and data thus collected soon became of great assistance to civil engineers and others engaged in questions of water supply. In the course of time Mr. Symons became the greatest authority on the distribution of rainfall over the country, and was an indispensable witness at Parliamentary Committees on questions of water supply. The Albert Medal of the Society of Arts was, in 1897, awarded to Mr. Symons "for the services he had rendered to the United Kingdom by affording to engineers engaged in the water supply and the sewage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself." It is a satisfaction to know that the rainfall organisation will not cease with his death, but will be carried on by his co-adjutor, Mr. H. Sowerby Wallis.

In 1866 he commenced the publication of *Symons's Monthly Meteorological Magazine*, which has been continued up to the present time.

Mr. Symons was elected a Fellow of the Royal Meteorological Society in 1856, and served on the Council from 1863. He was President in 1880–81, and Secretary in 1873–79, and also in 1882–99. He was elected President a second time in January last, in view of the Jubilee of the Society taking place during the present year; but, owing to his being seized with paralysis, he had to resign this office at the following Council meeting. He was elected a Fellow of the Royal Society in 1878, and at the last anniversary meeting was made a member of the Council.

Mr. Symons was a regular attendant at the meetings of the British Association, and served on several of the committees. He was also for some time on the Council of the Royal Botanic Society and of the Sanitary Institute. He was also Chevalier de la Légion d'Honneur.

Mr. Symons was a keen bibliophile, and had a very valuable meteorological library. Among his publications may be mentioned: Merle's MSS. "Consideraciones Temperiei pro 7½ annis 1337–1344"; "Rain—how, when, where, why it is measured"; "Pocket Altitude Tables" (3 editions); "The Floating Island of Derwentwater"; and "The East Anglia Earthquake." He was a most genial and amiable man, and had the power of drawing around him a vast number of friends and voluntary observers, who will deeply mourn his loss.

## *NOTES.*

PROF. E. FISCHER, of the University of Berlin, has been elected a correspondant of the Paris Academy of Sciences, in the Section of Chemistry.

WE regret to see the announcement of the death of Dr. William Marcet, F.R.S., at Luxor, Egypt, in his seventy-second year. The death is also announced of Mr. William Thorpe, a vice-president of the Society of Chemical Industry.

PROF. D. E. HUGHES, F.R.S., whose whole estate has been valued at 473,034*l.* gross, including personality of the net value of 472,704*l.*, has left the greater part of his property to the Middlesex Hospital, London Hospital, King's College Hospital, and Charing Cross Hospital. A considerable sum has also been left to various scientific societies. By his will of May 9, 1893, he bequeathed to the Institution of Electrical Engineers, of which he was a past president, 2000*l.* for a David Hughes Scholarship Fund, similar to the Sir David Solomons Scholarship Fund; to the Société internationale des Electriciens in Paris, of which he was a member, 2000*l.* for a scholarship fund; to the Royal Society, 4000*l.* to apply the income in prizes for original discoveries in physical sciences, particularly in electricity and magnetism; to the Paris Academy of Sciences, 4000*l.* for the same purposes; and to the Royal Institution of Great Britain, in Albemarle-street, 1000*l.* for its general purposes. The sum at present available for the Hughes Hospital Fund seems likely to be between 300,000*l.* and 350,000*l.*, and eventually over 400,000*l.*

REFERRING to the death of Mr. Leander J. McCormick, of Chicago, at the age of eighty-one, the *Athenaeum* recalls the fact that he was an inventor of agricultural machinery as well as a munificent patron of astronomical science. His father was the well-known Robert McCormick, of Virginia, a pioneer in the construction of apparatus for reaping by machinery. At his death, in 1846, the development and improvement of the mechanism of the original reaper devolved upon the son, himself a man of skill and resource. As regards the encouragement of astronomical research Mr. McCormick was no laggard, and he stands out prominently among those American citizens who have liberally contributed to the promotion of the work of observation. He gave to the University of Virginia the existing astronomical observatory which bears his name, the cost of building and equipment reaching the total of 20,000*l.* It was the desire of Mr. McCormick that the telescope and equipment should be the best of the kind in the world, and at the time of inauguration such was probably the case.

THE Memorandum by the Financial Secretary to the Treasury on the estimates for Civil Services for the year ending March 31, 1901, has just been issued as a Parliamentary paper. Among the works entailing additional expenditure are included the adaptation of the Imperial Institute (London University) buildings, 8770*l.*; a new Die and Medal Department of the Royal Mint, 8300*l.*; and Census Office buildings, 4000*l.* The addition of 5751*l.* for the Local Government Board includes 4000*l.* for extended arrangements for the supply of glycerinated calf-lymph. An interesting item is that on the Science and Art Department services the increase of 26,643*l.* is required mainly to meet the growing requirement for grants to science classes and schools of science. It is further mentioned that provision has been made for changes of organisation which have been adopted on the recommendation of the Departmental Committee appointed to consider measures for carrying into effect the Board of Education Act, which comes into force on April 1. A new item in the vote for scientific investigation is that of 11,250*l.* for a grant in aid of the National Antarctic Expedition, being the first of four annual instalments which are proposed to make up a total Government contribution of 45,000*l.* Reference is made to the fact that the total Government contribution in aid of the expenses of the Royal Commission for the British Section at the Paris International Exhibition, 1900, will be made up to 125,000*l.*

WE learn from *Science* that the Committee of Mines and Mining of the House of Representatives has reported favourably on a bill creating a department of mines and mining, with a cabinet minister. The Geological Survey would be transferred to this department. There is also a bill before Congress establishing a department of Commerce and Manufactures, to which it is proposed to transfer the U.S. Geological Survey, as well as the U.S. Coast and Geodetic Survey, the Patent Office, the Commission of Fish and Fisheries, and the Bureau of Navigation. The Treasury Bureau of Statistics and the Bureau of Foreign Commerce of the State Department are to be consolidated into a single bureau of the department. The principal new offices created are the secretary and assistant secretary of commerce and industries, the secretary receiving a salary of 8000 dollars and the assistant secretary 4000 dollars.

THE report of the Council of the National Association for the Prevention of Consumption and other forms of tuberculosis, presented to the first annual meeting on Tuesday, was a very satisfactory expression of the growth and activity of the Association since its foundation. With the object of focussing the information obtained concerning tuberculosis, an international congress will be held in London next year, under the presidency of the Prince of Wales, who will open it in person. The Council have received many representations, both from individuals and societies, as to the wide-spread habit of spitting on pavements, and more especially in vehicles and closed public places. As this habit is not only offensive, but a direct cause of spreading consumption, the Council have asked the various railway companies to post up on their premises a card printed by the Association urging persons to repress as far as possible the highly dangerous habit. Consideration has been given to the preparation of a leaflet on the treatment of milk, but in view of the researches that are still being made as to methods of sterilisation, publication has been postponed until some more definite results have been arrived at. Despite correspondence urging them to bring pressure on the Government for more stringent legislation in respect of supervision of milk and meat, the Council have considered it advisable to confine their efforts, for the present, more to the enlightenment of public opinion than to agitation of a political character.

A MEMORIAL pamphlet in appreciation of the late Josef Loschmidt, Professor of Physics in the University of Vienna from 1868 to 1891, has been issued by the Vienna Loschmidt Memorial Committee. This Committee was formed largely at the instigation of the Chemical and Physical Society of Vienna, for erecting a monumental tablet to the illustrious physicist within the precints of the University, and the object of the Committee was achieved on November 5 of last year, when the monument was unveiled in the presence of a large assembly. It occupies a fitting place opposite the memorial to Stefan, by whom Loschmidt was first put in the way of prosecuting scientific researches in 1867. The pamphlet now issued by the Committee includes the obituary discourse delivered to the Society by Prof. Boltzmann shortly after Loschmidt's death, and an account of the proceedings at the unveiling of the memorial, including speeches by the Oberst von Obermayer, Chairman of the Committee, Prof. Neumann, Rector of the University, and an oration on the work of Loschmidt by Prof. Boltzmann, than whom none could better appreciate his contributions to the advancement of our knowledge of molecular physics.

AN interesting series of observations on the temperature of the animal body during fasting, and the rate of assimilation of carbohydrates, is described by Prof. Ugolino Mosso in the *Atti dei Lincei*, the experiments being conducted in the University of Genoa. The experiments are particularly interesting in establishing the efficacy of sugar in raising the temperature of an animal which has fallen during a period of fasting. Thus, from one to four grammes of sugar per kilogramme cause a rapid rise of

temperature in the first ten or fifteen minutes; in from one to two hours the temperature reaches its maximum, and remains constant or elevated for an interval of time varying with the amount of sugar introduced. This effect of sugar is most marked after a long fast when the temperature is lowest. The action of bread is, in some respects, opposite in character. The temperature rises more slowly after the introduction of bread than after sugar; and the rise in this case is most rapid for animals whose period of starvation has been short, and whose temperature is not too low. These results are in accordance with the view that sugar is more readily assimilated by a starving animal than bread. Indeed, Prof. Mosso states that with sugar he has succeeded in restoring the vitality of dogs in a serious state of hypothermia, while the administration of albumen to others failed to save their life.

THE *Annuaire* of the Royal Observatory of Belgium for the year 1900 contains an interesting article on the employment of kites in meteorology, by J. Vincent. The paper is divided into several sections and includes: (1) a description of the different kites in use, with particulars relating to their construction, accompanied by diagrams, and a discussion of the objects to be attained by the ascents; (2) a chronological list of the ascents made since 1749; and (3) a bibliographical sketch containing over 100 references to articles which have appeared in various journals from 1896–9, and other useful information. The paper is also reprinted separately in pamphlet form.

WE have received from the Manila Observatory a discussion of the typhoons of the Philippine Archipelago and adjacent seas for the years 1895 and 1896, by the Rev. J. P. Doyle. The experience gained at the Observatory shows that these cyclones have a distinct zone of origin, and that the tracks follow an average definite course according to each of the following three groups of months in which they occur:—(1) December to March; (2) April, May, October and November; (3) June to September. The three zones in which the storms originate are included between lat. 4° and 20° N., and long. 129° and 144° E., and these have been accordingly discussed with reference to those groups of months, especial attention being given to those storms which have particularly affected the Archipelago. The discussions are accompanied by maps showing the tracks, and the whole work is a valuable contribution to our knowledge of tropical storms and to maritime meteorology.

IN a paper published in the *Bollettino* of the Italian Seismological Society, Dr. E. Oddone discusses the long-period oscillations of distant earthquakes. He considers that the problem of their origin is still unsolved. We have not yet succeeded in deducing with certainty the true movement of the ground from the diagrams supplied by microseismographs. The suggestion that they are slow undulations of the earth's surface is not universally accepted; but, on the other hand, the attempt to explain the records by horizontal movements only has also failed.

THE *Journal* (vol. xi. part iv.) of the College of Science, Imperial University, Tokyo, has been received. It contains three papers, the first, by Dr. K. Honda, on the mutual influence between longitudinal and circular magnetisations in iron and nickel. The other two papers, by the late Prof. Sekiya and by Prof. Omori, deal with the catalogue of Japanese earthquakes prepared by the Earthquake Investigation Committee, and have been noticed already in these columns (p. 282).

ANY information about the natives of the mysterious Easter Island is welcome, and we note with pleasure a paper by Dr. H. Stolpe, on their tatuing. In this paper (*Abhandl. u. Berichte . K. Zool. u. Anth. zu Mus. Dresden*, 1899. Bd. viii Festschrift für A. B. Meyer. Nr. 6) the author brings together all that is known on the subject. This consists mainly of some original observations made when Dr. Stolpe was voyaging in the Pacific, and he also gives details of a remarkable tapa figure which was in the museum of the Lit. and Phil. Society of Belfast, but is now in the British Museum. A degraded human face and a bird enter into the scheme of tatuing, but there is no information as to the signification of the ornamentation. In the same volume is a list of words relating to Philippino ethnographical and zoological objects, by Prof. F. Blumentritt; and some ethnographical notes, by R. Parkinson and Dr. W. Foy, on the natives of "Neu Pommern," New Britain. Drs. W. Foy and O. Richter have prepared a memoir on the decorative art of Timor, illustrated with 38 figures; this is a useful addition to the literature on the decorative art of Malaysia. The authors trace the degeneration of one or two simple patterns, and they demonstrate the presence of a lizard or crocodile *motive*; but in all such investigations it is highly desirable to obtain information on the spot as to the significance of local designs, for otherwise one is working very much in the dark.

TO the *Biologisches Centralblatt* for March, Dr. von Linden contributes a paper on the developmental history of the newts and salamanders of Germany, in which the various larval stages, and in some cases the adults, of the different forms are illustrated. Especial attention is directed to the development of the spotting, which always commences as longitudinal lines.

THE last two parts of *Indian Museum Notes* for 1899 are just to hand. No. 4 should attract a more than ordinarily wide share of interest from the fact that the greater portion of it is devoted to a report on Indian insect-pests by Mr. E. Barlow, of the Museum. It includes notes on insects harmful to tea, cereals, cotton, poppy, indigo and sugar-cane, as well as locusts, insects infesting fruit-trees, &c. Very serious damage appears to have been done to the tea industry in the Darjiling district, in the spring of 1897, by the caterpillars of a moth which appeared in millions and stripped the bushes of their old leaves. Although the species is fully diagnosed in his report, Mr. Barlow, as in the case of other pests, has omitted to suggest any remedy for its devastations.

JUDGING from its sixty-eighth *Annual Report*, which has just been issued, the Royal Zoological Society of Ireland appears to be in a flourishing condition, the receipts for the past year showing a noticeable increase over the average. The lion-breeding, which forms such a notable feature in the menagerie, was at one time in a somewhat unsatisfactory condition, but by the importation of fresh blood and the assistance of foster-mothers in cases where the female parents would not nurse their own cubs, the difficulties have been overcome. It is satisfactory to note that the Cape Hunting-Dog bred in the menagerie the previous season is growing apace, and will soon rival its parents in size. A feature of the *Report* is the inclusion of photogravures of several of the more interesting animals now living in the Society's gardens.

WE have received from the Royal Dublin Society a memoir on Jamaican Actiniaria, by Mr. J. E. Duerden, who was, if we mistake not, a student at the Royal College of Science, London, and afterwards one of Prof. Haddon's pupils or assistants at Dublin. Since his appointment as curator of the museum at Jamaica, Mr. Duerden has published quite a series of papers on the zoology of his neighbourhood—papers ranging over a wide field, from sea-anemones to the mongoose. The present memoir is the second part of a systematic account of the Actiniaria of the seas around Jamaica, and it deals mainly with the Stichodactylinæ, of which seven species are described. Part i.,

published two years ago, treated of the Zoantheæ, to which group three new species are now added. The descriptions are full, the drawings on the plates are admirable, and we are glad to notice long and important sections on the "anatomy and histology" of each species.

MR. LESTER F. WARD describes a new genus (*Cycadella*), and twenty new species of fossil Cycadean trunks from the Upper Jurassic freshwater beds of Wyoming, in the *Proceedings* of the Washington Academy of Sciences for February.

THE Wellington College Natural History Society continues to encourage an interest in scientific matters among members of the school. The latest report shows that during last year instructive lectures were given upon a number of scientific subjects, such as bacteria, extinct animals, ants, and Röntgen rays. The Pender prize, for the best essay on a scientific subject, was awarded to H. O. O'Hagan for a thoughtful paper on "Thames Fish, and their Habits," containing original observations of much interest. In order to further aid natural history work in the school, a field club has been started, the members of which propose to thoroughly explore the immediate neighbourhood for the purpose of making new, and revising old, lists of objects, and to start a local museum.

THE number of the *Irish Naturalist* for February 1900 contains a description by Mr. David McArdle, with an illustrative plate of the rare and little-known liverwort, *Lejeunia Rossettiana*, distinguished by the remarkable echinate hygroscopic hairs on the capsule. It was found on Ross Island, Killarney.

SCIENTIFIC bibliophiles will be interested to know that Messrs. H. Sotheran and Co., and Messrs. John Wheldon and Co., have just issued catalogues containing many rare and second-hand scientific books which they offer for sale.

NEW editions of Mr. W. T. Lynn's handy booklets on "Remarkable Eclipses" and "Remarkable Comets" have been published by Mr. E. Stanford. At the end of the latter a list of the dates of the next returns of comets observed at more than one appearance is given. The comets due this year are:—Summer, De Vico's comet, rediscovered by Swift in 1894 (period 5½ years); and towards winter, Barnard's comet (period 5½ years).

THE first part of a work on "L'électricité en Physiologie," by Prof. L. Morokhowetz, professor of physiology and director of the physiological institute of the Imperial University of Moscow, has just been received. It is proposed in the complete work to describe the present state of knowledge of the influence of electricity on the animal organism and in animal electricity. The present chapter deals with electrostatic principles and instruments used in electro-physiology. The publishers of the work are A. Lang and F. Tastevin, Moscow.

WE have received *The Naturalist's Directory* (Upcott Gill) for 1900. It contains a large number of names, and is undoubtedly a useful little volume. But there seems a tendency to glorify the pushing amateur at the expense of the real scientific worker. In the list of British zoologists we notice, for example, the absence of the names of Mr. W. T. Blanford and the editor of the "Royal Natural History"; while the foreign list, when it omits names like Bocage, Collett, Merriam and Milne-Edwards, is ludicrously inadequate to its purpose.

AN enlarged and revised edition of Huxley's "Lessons in Elementary Physiology," prepared by Sir Michael Foster, K.C.B., and Dr. Sheridan Lea, F.R.S., will be published almost immediately by Messrs. Macmillan and Co. The book originally appeared in 1866, and the last new edition was issued in 1885, though since then it has been reprinted six times. Revision was therefore urgently needed in order to bring the book in line with progress in science and education during more recent years. This has been carried out in sympathy with Huxley's original aims and methods, so that the book should have as successful a career in the future as it has had in the past.

MESSRS. EVERETT AND CO. have issued a catalogue of some of the instruments made by them for use in electrical and physical laboratories and workshops. Galvanometers, resistance coils and Wheatstone Bridges, electrometers, rheostats, and other instruments required in electrical work in the laboratory and testing-room, form a prominent feature of the catalogue. Among the apparatus specially designed for laboratory tuition we notice arrangements for demonstrating the laws of the galvanometer, for measuring the temperature coefficients of electrical alloys, and for determining the linear expansions of metal rods.

THE methods employed by Prof. Moissan in the preparation of diamonds by artificial means, using his electric furnace, are popularly described by Mr. R. H. Sherard in the March number of *Pearson's Magazine*. Expressions such as "the highest degree of heat," and "a heat of from 4000 to 5000 degrees Centigrade," suggest that the revision of the article by some one acquainted with the distinction between heat and temperature would have prevented a confusion of ideas. Another contribution to the same magazine is "Stories of other Worlds," by Mr. George Griffith. A trip is made (in imagination) to the planet Venus, and fact is combined with fancy in describing the features of the planet and inhabitants. But the human element looms so large that the story lacks the verisimilitude which characterises Mr. H. G. Wells's treatment of scientific themes.

MESSRS. MACMILLAN AND CO. are about to publish a third and completely revised edition of a work on "Micro-organisms and Fermentation," by Dr. Alfred Jorgenson, Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. The original aim of the book was to give an account of the morphology and biology of the micro-organisms of fermentation, and so to supplement the treatment in text-books of the chemical side of the subject. To the new edition have been added a biological treatment, performed in the author's laboratory, of several English high-fermentation yeasts, isolated from yeast used in breweries and distilleries in various parts; a summary of observations on the variations which yeast undergoes during its use in factories; and a concise account of the organisms occurring in milk, and of the use of lactic acid bacteria in dairies and distilleries. The book thus appeals to chemists, botanists and biologists, as well as to technologists engaged in the fermentation industries.

A NEW gas furnace has been designed by M. Armand Gautier which will be of great service in researches in which a tube has to be kept at a constant high temperature for long periods of time. The principle of the muffle is applied to the ordinary tube combustion furnace, and M. Gautier has been able to keep a tube at any temperature between 150° and 800° for hours together without a greater variation than ± 5°. Even at 1200°, if a good governor is interposed between the gas main and the furnace, the variations do not exceed 20°. A detailed description, with drawings, is given in the current number of the *Comptes rendus*.

SINCE M. Moissan has found that the original platinum-iridium apparatus may be replaced by a U-tube of copper, it has been possible to study without difficulty reactions requiring considerable quantities of fluorine. In the current number of the *Comptes rendus*, M. Moissan gives an account of a new fluoride

of manganese he has obtained, which is of interest from the point of view of the valency of the metal. Fluorine gas reacts readily with powdered manganese, and analyses of the resulting product showed that a higher fluoride than $MnF_2$ was formed, but owing to the violence of the reaction this fluoride was not of constant composition. The interaction of fluorine and manganous iodide, however, gave a definite fluoride, $Mn_2F_6$, which in many of its reactions behaves like free fluorine, pentachloride of phosphorus giving $PF_5$, and amorphous carbon a fluoride of carbon. On heating it splits up into $MnF_2$ and fluorine gas.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*, ♀) from Nigeria, presented by Mr. Cecil Masters; a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Mrs. Herbert Griffith; a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, presented by Mrs. Walter Crane; a Persian Gazelle (*Gazella subgutturosa*, ♂) from the Persian Gulf, presented by Mr. B. T. Finch; an Alligator (*Alligator mississippiensis*) from North America, presented by Mr. J. Turner Turner; a Ludio Monkey (*Cercopithecus ludio*) from West Africa, a Brown Capuchin (*Cebus fatuellus*) from Guiana, deposited; four Cockateels (*Callopsittacus novae-hollandiae*) from Australia, purchased.

## OUR ASTRONOMICAL COLUMN.

SEARCH FOR AN INTRAMERCURIAL PLANET.—*Harvard College Observatory Circular*, No. 48, consists of a description of a plan, prepared by Prof. W. H. Pickering, for observations during the coming eclipse of the sun, with the object of making a thoroughly systematic search for a possible planet revolving between Mercury and the sun. It is not usual for the observatory to arrange expeditions for solar eclipses, except in the case of the trial of a new problem, when grants of money and instruments are made especially for such work.

In explanation of his plan, Prof. Pickering starts with the statement of the observed fact that "the faintness of a star that may be photographed with a given instrument against a *bright* background of sky depends, within certain limits, directly on the focal length of the lens, and is independent of its aperture." It has also been previously pointed out (*Harvard Observatory Annals*, xviii. p. 104) that "three minutes after the pole star first becomes visible to the naked eye in the evening, the sky surrounding it is of about the same photographic intensity as that of the sky near the sun during a total solar eclipse."

Using a photographic lens of 3 inches aperture and 11 feet 4 inches focal length, the field was large enough to cover nine 8 × 10 inch plates. With an exposure of one minute to the region of the pole, about three minutes after the pole star became visible, was sufficient to appreciably darken the plate, but not enough to obscure the images of stars down to the eighth magnitude. *Four* of these instruments will be employed in May next, all attached to the same mounting, and arranged so as to photograph a region about 32° × 10°, having the sun as centre.

As the earth passes through the equatorial plane of the sun only about *one week* after the eclipse, this will be a favourable time for such a search, as the planet would appear somewhere on the narrow line forming the projection of this plane upon the celestial sphere.

The Harvard Expedition for this purpose will be stationed in the State of Alabama, but as even a successful observation at *only one* station will be insufficient to compute the orbit or determine its distance from the sun, it is therefore hoped that some other observer will be able to duplicate the work in Spain or Algeria. Athough, of course, it would be desirable to also employ four cameras, if possible, this is not necessary, and two lenses, one photographing the region on each side of the sun, would, in conjunction with the Harvard plates, be sufficient to confirm the discovery and permit the computation of an approximate circular orbit, which could then be more accurately determined at the next eclipse in 1901.

THE NEW TWIN REFRACTOR AT POTSDAM.—The great refractor which has been installed at the Astrophysical Observatory at Potsdam was recently formally dedicated and prepared for its assigned work. Director H. C. Vogel gave the inaugural address, after which the instrument and its observatory were explained by Prof. Scheiner. The telescope has two objectives, one of 80 cm. (32 inches) aperture and 12 m. (39·4 feet) focal length, and another of 50 cm. (20 inches) aperture and 12½ m. (41·2 feet) focal length. Both objectives were made by C. A. Steinheil and Sons, of Munich, the larger being corrected for photographic, the smaller for visual use. The mounting is by Repsold and Sons, of Hamburg. The dome is 22 m. in diameter and 18 m. high, the hemispherical movable part being of iron with an inner lining of wood; this may be rotated either by hand or by means of electric power. The observing platform is rather unusual, being suspended from the dome, with which it moves, directly opposite the observing slit. The motion of this plattorm, and the opening or closing of the slit in the dome, are controlled electrically from the eye end of the telescope. The instrument is to be primarily devoted to the determination of the velocity in the line of sight of 500 stars, and the two spectrographs, built specially for the telescope by Toepfer, have passed successfully the preliminary tests. An excellent reproduction of the instrument in position forms the frontispiece of the *Astrophysical Journal* for January 1900, from which the above details have been abstracted.

THE BENJAMIN ALTHORP GOULD FUND.—In the *Astronomical Journal*, No. 477, Messrs. Lewis Boss, Seth C. Chandler and Asaph Hall, Directors of the Fund, make the following announcement:—"Since making appropriations, in March 1899, of 500 dollars to Prof. Charles L. Doolittle, and of 300 dollars to Mr. Henry M. Parkhurst, from the Benjamin Althorp Gould Fund, a considerable amount of income has accrued, for the distribution of which the Directors are prepared immediately to arrange. Applications for appropriations may be made by letter to any of the aforesaid directors, stating the amount desired, the nature of the proposed investigation, and the manner in which the appropriation is to be expended. Full information with regard to the Fund may be found in the announcement pertaining thereto in *A.J.* 453, a copy of which will be mailed, on request, to assist in framing applications."

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. H. Woods, St. John's College, has been appointed University Lecturer in Palæozoology.

The Medical School Buildings' Syndicate report in favour of plans for the schools of pathology, pharmacology, public health and medicine, prepared by Mr. E. S. Prior. The estimated cost is about 35,000*l*.

The degree of Doctor of Science is to be conferred on Mr. Charles Hose, of Saráwak, whose contributions to the ethnology, zoology and botany of Borneo have won for him a high reputation.

THE honorary degree of Doctor of Laws has been conferred upon Prof. A. R. Forsyth, F.R.S., and Prof. A. S. Woodward, by Glasgow University.

EVERY student before graduating from the Massachusetts Institute of Technology has to present a satisfactory thesis. Time is allowed for this work in the second term of the fourth year. The theses thus afford students an excellent opportunity to perform original research work. In the course of electrical engineering, a Japanese student has chosen for his subject a study of the size of wire necessary when aluminium is used for a conductor of electricity. He is to study the relative capacity of aluminium as compared with that of copper. As the price of copper has risen so much, and as the price of aluminium has fallen, the use of the latter metal has already begun to compete with that of copper in electrical manufacture. Insurance companies have appointed a committee to follow the results of such tests, and to make tables from them, as it is most important to know, when buildings are wired, the safe limit of the amount of current which any wire covered or uncovered may be made to carry. In the method chosen for determining the relative capacity of the aluminium, the temperature of the wire is measured directly, while the wire is carrying different amounts of electricity.

EVIDENCE of progress in various departments and grades of education in Liverpool is afforded by the report of the Technical Instruction Committee for the year 1899. Though nothing has yet been done by legislation to improve the local organisation of education, or to promote the unification of local administration, steps have been taken in Liverpool towards the co-ordination of educational effort in the City, and so promote harmonious development. By reconstituting its Technical Instruction Committee so as to include not only educational experts nominated by the City Council itself, but also a considerable proportion of representatives of the School Board, and others nominated by the University College and the secondary schools, a local authority has been established for the administration of technical and secondary education—though the functions of the Committee as regards the latter branch are necessarily for the present mainly consultative and advisory. By bringing within the influence of one administrative body, consisting of representatives from all the recognised important public and professional educational organisations in the City, the various special branches of Technical Education, the Committee hope to ensure the continued success and the progressive development of such work as is required by the needs of the City. As the Committee has been recognised by the Department of Science and Art as an organisation for the promotion of secondary education, it will be free to encourage any branches of technical and higher education which are considered deserving of support.

A RETURN just published as a Blue Book shows that the total amount expended on technical education during the year 1897–8 in England, Wales and Ireland was 860,105*l.*; and that the estimated total expenditure on technical education during the year 1898–9 was 874,612*l.* These amounts are exclusive of the sums allocated to intermediate and technical education under the Welsh Intermediate Education Act, 1889. The amounts raised by loan on the security of the local rate under the Technical Instruction Acts were—in 1897–8, 69,334*l.*; in 1898–9, 133,583*l.* The total amount of the residue received under the Local Taxation (Customs and Excise) Act, by the councils of counties and county boroughs in England (excepting the County of Monmouth) in respect of the financial year 1897–8 was 834,827*l.*, of which 759,400*l.* was appropriated to educational purposes, and 75,426*l.* to relief of rates; the latter sum including 42,108*l.* devoted by the London County Council to relief of rates. The total amount expended on technical education during the year 1897–8 was 826,450*l.*, and the estimated total expenditure during the year 1898–9 was 834,908*l.* The total amount of the residue paid to the thirteen County Councils and the Councils of the three County Boroughs in Wales and Monmouth was 40,062*l.*, and these local authorities are devoting the whole of it to intermediate and technical education, chiefly under the Welsh Intermediate Education Act, 1889. The estimated total amount to be devoted annually to intermediate and technical education, under the Welsh Intermediate Education Act—*i.e.* out of the residue and the local rate—is 43,304*l.* In the case of Ireland, the return shows that the total amount expended on technical education by twelve local authorities during the year 1897–8 was 5649*l.*, and that the estimated total expenditure on technical education by twelve local authorities during the year 1898–9 was 4523*l.*

PROF. ROBERT WALLACE, professor of agriculture and rural economy in the University of Edinburgh, does not agree with the suggestion of the Agricultural Education Committee that, in connection with elementary schools, provision should be made for practical work on plots of ground attached to the schools. In an address delivered a few weeks ago on "Nature Knowledge Teaching introduced by the Scotch Code of 1899" (Edinburgh: The Darien Press), he showed that many educational authorities at home and abroad are of the opinion that farm work at school as a means for training the sons of those who are engaged in agricultural pursuits is impracticable and valueless. Such work would only be playing at farming, and would not rouse into full vigour the real working power of a boy any more than playing at shops develops a knowledge of the laws of commerce. What is wanted is individual interest and responsibility, and a knowledge of principles. The practical work which might usefully be done is stated by Prof. Wallace as follows:—(*a*) Laboratory work, the collection of specimens of all sorts of suitable interesting objects, to form local school museums and home collections. (*b*) The systematic examination of specimens by the aid of lenses and other means. (*c*) The growth, for experimental purposes or for ornament, of a great variety of seeds, and of a select number of plants from bulbs, roots, and cuttings in flower-pots, which, on a scale suitable to the local circumstances, could be duplicated at home by individual pupils, by the pupils from one household, and even by groups of pupils who live contiguous to each other—it being so arranged that each member of the combination should have a right to claim the necessary attention to one or more pots as exclusively his or her own, while the lessons to be learned from all the pots would be common to every one. (*d*) Field demonstrations, in which the objects of interest would be, so to say, infinite in variety. (*e*) And for the benefit of older children and those who have left school, as well as the more enlightened of their parents, school libraries of useful books on rural subjects, which every one could not be expected to possess.

THE address delivered before the Association of Technical Institutions, on January 24, by the President, Sir Swire Smith, just published by the Association, contains many sound remarks upon technical education from the commercial and industrial aspects, and reasons why it should receive the most liberal national encouragement. A University Don once remarked to the parent who wished his son to take up some scientific subject: "Sir, we know nothing of science here, we don't even teach it," and this spirit (unfortunately, not unknown at the present time) is responsible for the prejudice which manufacturers have against the schools and higher education. Place by the side of the disdainful expression referred to, the following testimony of Sir Swire Smith as to the methods and benefits of education in the principles of science:—"In the dual enquiry of the Royal Commission on technical instruction, in which we investigated not only systems of education, but their effect upon industry in this and competing countries, we visited in each foreign country, wherever possible, those eminent industrial establishments whose products were largely exported to the United Kingdom. We followed the processes from the raw material to the finished product, and we interviewed the specialists responsible for excellence or superiority, nearly all of whom had been trained in technical schools. In visiting the schools in which this special knowledge had been obtained, we found students qualifying themselves for their special work in the factory, by pursuing courses of training under excellent teachers and with the most perfect apparatus. We did not see much of what may be called 'trade teaching,' although in some departments of industry, in textiles, for example, the designing, weaving, dyeing and finishing departments were in some cases very complete. The schools in their fundamental principles were claimed to be schools of science or art, *applied* to industry, and in many of the smaller towns the most important schools were teaching pure science and pure art as a basis, with departments for the application of science and art to local industries. The teaching of principles was the same in all the great schools, but in their application there was as much variety as in the industries and crafts to which the teaching was applied. But in following the students from the schools to the workshops and factories, and in ascertaining the effect of their instruction upon their calling, the evidence to my mind was conclusive that the great progress of our rivals may be traced directly to the influences of their schools. And not less convincing were the illustrations of technical training afforded under less favourable conditions than in our own country, proving that the same educational influences had been at work in advancing our own industries." No more sound expression as to what technical education should mean, and what may be expected from it, could be given than is included in Sir Swire Smith's remarks, and they should receive careful consideration from all who are concerned with the progress of national education and the development of our industries.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society**, January 25.—"On the Effects of Strain on the Thermo-electric Qualities of Metals. Part ii." By Prof. Magnus Maclean, D.Sc. Communicated by Lord Kelvin, G.C.V.O., F.R.S.

A.—"Thermo-electric difference between free wires and wires previously subjected to longitudinal extension and lateral compression, by drawing them through the holes of a draw-plate."

In Part i. of this paper, read to the Society on February 2, 1899, the object of the experiments was stated to be the determination of the *magnitude* of the thermo-electric effects obtained from any one metal strained and unstrained. The results then given were obtained from two wires of the same material, one wire being previously drawn through a draw-plate, so as to reduce it in size from No. 18 standard gauge (0·122 cm. diameter) to about No. 24 standard gauge (0·0559 cm. diameter).

The metals for which results were given in Part i. were copper (six specimens), lead (two specimens), platinoid, German silver, reostene and manganin.[1]

The present paper gives results of similar experiments made on specimens of commercial[2] and pure lead, obtained from Messrs. Johnson and Matthey; and specimens of annealed steel, of aluminium, and of nickel.

B.—"Thermo-electric difference between free wires and wires previously permanently elongated by longitudinal stresses."

Attempts were made to determine the thermo-electric difference between free wires and wires previously permanently elongated by a longitudinal stress. It was found difficult to elongate the hard wires permanently to any appreciable extent before they broke.

The greatest percentage permanent elongation that could be got in hard drawn copper, manganin, nickel and German silver was 0·7, 0·5, 0·7 and 0·5 respectively. The thermo-electric difference between the stretched and the unstretched wires was then determined, and the results are given.

C.—"Thermo-electric difference between free wires and wires under stress, producing (1) temporary elongation, (2) permanent elongation."

The hot junction was kept permanently at steam temperature during each set of experiments by an arrangement described. Increasing weights were added on to the wire to produce (1) temporary elongation, (2) permanent elongation. Three readings of the galvanometer were taken: (1) with a weight on the wire, (2) with a weight off, and (3) with the circuit broken. A heavier weight was hung on, and other three readings taken, and so on to the heaviest weight used in the experiments.

The readings of the galvanometer were in the same direction for all the wires tried with weights on and off, except for soft copper and iron. The greatest permanent elongation produced in any of the hard copper wires experimented on was 0·17 per cent., and for this permanent elongation the reading on the galvanometer was in the same direction for weights off and on, though always greater for the latter.

For the soft copper wire the readings were in the same direction for weights on and off up to a permanent elongation of 1 per cent. After a permanent elongation of 4·72 per cent. the current with weight on was 0·00103 mikroampere per degree from *stretched* to *unstretched* through the hot junction, while with the weight off the current was 0·00075 mikroampere per degree from *unstretched* to *stretched* through the hot junction.

For iron wire the current was in the same direction for weights on and off up to a permanent elongation of 0·35 per cent.; but after a permanent elongation of 3·41 per cent. the current with weight on was 0·00461 mikroampere per degree from *unstretched* to *stretched* through the hot junction, and with weight off 0·0069 mikroampere per degree from *stretched* to *unstretched* through the hot junction.

In "Mathematical and Physical Papers," vol. 2, p. 270, § 109, Kelvin says:—"I have thus arrived at the remarkable conclusion that when a permanent elongation is left after the withdrawal of a longitudinal force which has been applied to an iron or copper wire, the residual thermo-electric effect is the reverse of the thermo-electric effect which is induced by the force, and which subsists as long as the force acts."

It seems (1) that for small longitudinal strain in copper or in iron the direction of the current through the hot junction is the same, whether the force which produced the permanent strain is on or off, (2) that as the permanent elongation is increased by increased longitudinal forces, a stage is reached which gives zero current when the forces are removed, and (3) that for greater longitudinal forces and permanent elongations the direction of the current is opposite with the pulling forces off and on. It seems, in fact, that the permanent elongation must exceed a definite limit to produce the reverse thermo-electric effects which Kelvin observed with the longitudinal force on and removed. I hope to further investigate this point and to report the results to the Society.

[1] Dr. Anderson, Chemical Laboratory, the University, Glasgow, gave me the following analyses for reostene and for manganin:—

| Reostene. | | | Manganin. | | |
|---|---|---|---|---|---|
| Si | ... ... | 0·61 per cent. | Sn | ... ... | 0·073 per cent. |
| Fe | ... ... | 79·95 ,, | Fe | ... ... | 0·6 ,, |
| Ni | ... ... | 16·53 ,, | Cu | ... ... | 86·62 ,, |
| Mn | ... ... | 1·21 ,, | Mn | ... ... | 8·031 ,, |
| | Total ... | 98·30 | Ni | ... ... | 3·261 ,, |
| | | | | Total ... | 98·585 |

[2] Dr. Anderson analysed the commercial lead, and found it contained 99·12 per cent. of lead.

**Physical Society**, March 9.—Prof. Everett, F.R.S., Vice-President, in the chair.—A paper on the damping of galvanometer needles was read by Mr. M. Solomon. The solution of the equation of motion for a magnetic needle, swinging in a uniform magnetic field, points to the conclusion that the ratio of the period to the logarithmic decrement is independent of either the moment of the needle or the strength of the controlling field, and is simply a function of the damping coefficient and the moment of inertia of the moving system. This ratio should therefore be constant if these latter quantities are constant. Experiments to test the constancy of period to logarithmic decrement have been conducted at the Central Technical College at various times since 1891, and they have invariably pointed to a variation in the value of the ratio. The object of the present paper is to discover the cause of this variation. It may be due to an alteration in the moment of inertia or to an alteration in the damping coefficient. If the control magnets are either directly above or directly below the needle, there is no chance of any change in moment of inertia. The damping coefficient depends on three things: (1) Viscosity of the air; (2) viscosity of the suspension; and (3) eddy currents. The author has carried out experiments with a galvanometer on open circuit, and finds a constant value for the ratio. The viscosity of the air and suspension therefore cause no variation. Upon closing the circuit and repeating the experiments, the value of period over logarithmic decrements alters. The variation is therefore due to eddy currents. The damping factor due to eddy currents may vary owing to three causes: (1) Change in moment of needle due to change in field strength; (2) effects of self-induction; (3) effects of rise of temperature on the resistance of the coils. The author points out that the two latter causes would tend to alter the ratio in the wrong direction, and he therefore concludes that the variation is due to an alteration in the strength of the swinging needle produced by altering the strength of the controlling field. Mr. Blakesley said it was interesting to note the fact that the ratio of period to decrement was independent of the controlling field. In the case of a condenser discharging this ratio is independent of the capacity; in the case of a tuning fork, of the rigidity; and in the case of water oscillating up and down in a U-tube, of the acceleration due to gravity. Mr. Rosenbaum said that the ratio considered was constant in the case of a Nalder D'Arsonval galvanometer. Mr. Solomon said that his arguments did not apply to a galvanometer of this description, because the swinging system was not a magnetic needle but simply a coil.—A paper on the distribution of a gas in an electric field was read by Mr. G. W. Walker. The author has considered a gas as consisting of a number of molecules each containing two atoms of equal mass, one positively and the other negatively charged with electricity. When under the action of electrical forces some of the molecules split up, and we arrive eventually at a steady state in which there is a definite number of undissociated molecules and of free positive and free negative atoms. Treating the problem as one-dimensional the potential at any point is expressed in general by elliptic functions, and is therefore periodic. Applying the results to the case of a vacuum tube, it is found that there is superimposed upon the gradual fall of potential along the tube minor periodic variations which it is suggested are connected with the striæ of discharge. Both the matter density and the electric density are periodic along the tube. If the places of maximum matter density coincide with the places of minimum electrical action, then whether luminosity is due to collisions or recombinations there will be maximum luminosity at these points. In general these points do not coincide, and thus the positions of maximum luminosity are not clearly defined. The analysis leads to the conclusion that the distance between the striæ is inversely proportional to the density of the gas and to the current strength, and these facts have been experimentally verified.—Mr. C. E. S. Phillips exhibited a surface tension

lecture experiment. The effects of surface tension were exhibited by placing water between two pieces of microscope cover glass. When the glasses are circular they set in any position, and one can be made to rotate upon the other. If the plates are square or elliptical they set in a definite position, to which they immediately return if displaced. Mr. Phillips pointed out how two circular discs with liquid between could be used from which to suspend the moving system of a galvanometer. Mr. Cochrane suggested the use of some liquid which would evaporate less quickly than water. Mr. Blakesley asked what accuracy could be obtained with such an arrangement, and what weight it would be possible to support without squeezing out the water.—The meeting then adjourned until March 23.

**Zoological Society,** March 6.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair.—Mr. G. A. Boulenger, F.R.S., described eight new species of reptiles and batrachians from Borneo, which had been forwarded to him by Mr. R. Shelford, the curator of the Sarawak Museum. One of them formed the type of a new genus proposed to be named *Lepturophis*.—Mr. F. E. Beddard, F.R.S., read a description of the brain of the Siamang (*Hylobates syndactylus*), based upon a specimen taken from an animal which had recently died in the Society's Gardens. The form of the brain did not appear to differ materially from that of other species of *Hylobates*.—A communication from Miss E. M. Bowdler Sharpe contained a list of twenty-nine species of butterflies, of which specimens had been collected by Mr. J. Lewis Bonhote in the Bahama Islands in 1898. Of these, one species, viz. *Papilio bonhotei*, was described as new.—A communication was read from Mr. J. Lewis Bonhote, containing an account of the mammals collected by Mr. T. H. Lyle in Siam. The collection comprised specimens of twenty species, one of which, viz. *Petaurista lylei*, was described as new, and the others were enumerated in the paper. A large series of specimens of a squirrel (*Sciurus finlaysoni*) was contained in the collection, and from an examination of them the author was able to corroborate Mr. Thomas's remarks (*P.Z.S.* 1898, p. 245) that, so far as our present knowledge is concerned, the variations met with in this species follow, apparently, none of the ordinary laws which are usually supposed to govern such cases.—Mr. G. E. H. Barrett-Hamilton contributed a paper on a small collection of mammals brought home by Captain H. H. P. Deasy from Central Asia. The most interesting specimens were three examples of the rare *Euchoreutes naso*, a novelty to the collection in the British Museum, and specimens of new species of Vole and Jerboa.—Mr. Martin Jacoby read a paper on new species, one hundred in number, of Phytophagous Coleoptera from South and Central Africa.

CAMBRIDGE.

**Philosophical Society,** February 19.—Mr. Larmor, President, in the chair.—The President announced that the adjudicators of the Hopkins Prize for the period 1891–1894 have awarded the prize to W. D. Niven, F.R.S., formerly Fellow of Trinity College, for his memoir on ellipsoidal harmonics (*Phil. Trans.* 1891) and other valuable contributions to applied mathematics. The following communications were made to the Society:—A suggestion as to a possible explanation of the origin of some secondary sexual characters in animals as afforded by observations on certain salmonids, G. E. H. Barrett-Hamilton. Attention was directed to the phenomena attendant upon the spawning of the anadromous salmonids of the genus Onchorhynchus, which, it was suggested, would be found to throw light on the origin of secondary and other sexual characters in animals.—On supernumerary teeth, W. L. H. Duckworth and D. H. Fraser. The observations which were brought before the notice of the Society dealt with the occurrence of supernumerary teeth in adult human crania. The essential fact demonstrated was the frequent presence of small dental masses in a particular position on the alveolar margin of the upper jaw, viz. between the second pre-molar and the first molar teeth. The authors thought they were justified in the conclusion that some of these masses are to be regarded as vestiges of what would be third pre-molars, and inferred that the condition is consequently to be considered as constituting an approximation to the Platyrrhine type of primate dentition.—On the physical characteristics of some Eskimo from Labrador, W. L. H. Duckworth and B. H. Pain. The subjects of this communication are a party of Eskimo, some twenty-five in number, who were exhibited in the "Eskimo encampment" at "Olympia," in London, at the latter end of last year and in January of the present year. The observations dealt with the external characters of these people; measurements were obtained which conveyed an idea of their physical proportions, and some of their words were recorded by means of the phonograph. The measurements bear an interesting relation to those obtained from the skeletons of Eskimo from Labrador presented by Dr. Curwen, of St. John's College, to the University Anatomical Department.—On the zoological position of *Palaeospondylus*, J. Graham Kerr. Evidence was brought forward which suggested the possibility of *Palaeospondylus* being really a young Dipnoan fish.—On the extraction of gases from small quantities of blood, J. Barcroft. The principle of the apparatus demonstrated is the ordinary one of extracting the gases from measured quantities of blood in vacuous receivers with an air pump. The leading feature of the apparatus is that the measuring burette, the vacuous receivers and the gas pump are in one piece, so that there is no opportunity for the blood or the gases to be contaminated with air.—On the separation of a pure proteid from egg-white, F. G. Hopkins. A process was described by means of which a crystalline albumen can be obtained from egg-white, which upon repeated fractional crystallisation shows complete constancy of rotatory power and of percentage composition. It yields therefore satisfactory evidence of being a chemical individual, and should form satisfactory material for chemical study.

EDINBURGH.

**Royal Society,** February 5.—Prof. Duns in the chair.—Prof. J. Gibson and Mr. A. W. C. Menzies exhibited their form of thermostat, which is heated and regulated by electricity. The heating is effected by means of four or five ordinary incandescent electric lamps, set below the jacketed tank containing the water, whose temperature is to be kept steady. After the temperature has been raised to the desired point, a simple form of automatic cut-out is arranged to work an electric relay, which puts out the electric lamps when the temperature rises slightly above the desired temperature, and allows them to be re-lighted when the temperature falls slightly below that point. One important practical advantage of the method lay in the fact that the operator was rendered quite independent of the gas supply. By its means they had been able to keep the temperature steady within a range of a tenth of a degree for months, and at comparatively little cost.—Dr. W. Peddie read a paper on the law of elastic fatigue. In a former paper on the torsional oscillations of wires it was pointed out that the empirical formula, which very accurately represents the relation between amplitude of oscillation and the number of oscillations that have taken place since the wire was left to itself, indicates the existence of a condition in which elastic fatigue is diminished by previous oscillations of the wire. But the truth of this result depended, in the series of experiments then discussed, upon the formula applying, with unmodified parameters, to a range outside that dealt with in the experiments. It was now shown that, with one exception, fatigue had been induced by previous oscillations in all series of experiments hitherto made upon both steel and iron wires. In the exceptional case the reverse may be true in part of the experimental range. The angle of oscillation (provisionally called the *critical angle* in the former paper), which separates the two conditions, occurs well within the experimental range. At larger angles fatigue is induced by previous oscillations; at smaller angles it seems to be increased.—In a note on magnetic screening, Dr. C. G. Knott gave an account of a new method of exploring the field inside a hollow tube or sphere of magnetic metal, specially applicable to cases in which the interior is very narrow or difficult of access. The idea had been in his mind for many years, but only recently, in connection with an investigation on magnetic strains in small iron and nickel spherical shells, had he found occasion to test the method experimentally. The method consisted in comparing the twist produced in a nickel wire carrying a given current and magnetised longitudinally in various fields: (1) when the nickel wire alone occupied the heart of the magnetising coil; (2) when either the iron or nickel shell was introduced so that the nickel wire lay wholly within it. This required the nickel wire to be shorter than the diameter of the spherical shell. It was found, for example, that it required a field 660 when the iron shell surrounded the wire to produce the same twist effect as was produced by field 200 when the nickel shell surrounded the wire; and that the same effect was produced by field 50 when the wire was sur-

rounded by neither shell.—Dr. John Henderson communicated a paper on the Clark cell *versus* the cadmium cell as a standard of electromotive force. In addition to an account of the various modifications of Clark cell which had been made with a view to improve it as a satisfactory standard of E.M.F., and a discussion of the work done by others in regard to the cadmium cell, the author gave a full description of his own elaborate experiments. He experimented on a great variety of modifications; and his conclusions were that as regards constancy of E.M.F., smallness of temperature coefficient, power of recovery after being short-circuited, its practical identity though made of materials supplied commercially by different manufacturers, and other essential characteristics of a practical standard of electromotive force, the cadmium cell was in all respects superior to the Clark cell.—Dr. Hugh Marshall communicated a short paper on the action of silver salts on solution of ammonium persulphate, in which he called attention to two striking reactions which he had recently observed and was investigating. When a small quantity of silver salt is added to a strong ammoniacal solution of persulphate, nitrogen is evolved almost immediately; the temperature rises rapidly, and the action may soon become violent. Apparently the silver is rapidly peroxidised by the persulphate and reduced by the ammonia. An aqueous solution of ammonium persulphate is steadily decomposed at the ordinary temperature in presence of small quantities of silver salts; there is no evolution of gas, *part of the nitrogen of the ammonium salt being converted into nitric acid*, as shown by the equation:

$$8(NH_4)_2S_2O_8+6H_2O=7(NH_4)_2SO_4+9H_2SO_4+2HNO_3.$$

It was found that, in the space of two to three days a milligram-equivalent of silver salt per litre of solution decomposed one-half of the persulphate originally present, the temperature being 20°.

## PARIS.

**Academy of Sciences**, March 3.—Mr. Maurice Lévy in the chair.—Remarks by M. Picard on his work on the theory of algebraic functions of two variables.—On the tetrahedral symmetry of the terrestrial globe, by M. de Lapparent. Remarks on a paper on the same subject by M. Marcel Bertrand. The author thinks that while the original view of Lothian Green groups the main facts of the geography of the earth round a remarkably simple idea, an idea which moreover follows from the principle of least action, the modifications introduced by M. Bertrand into the original hypothesis have the effect of destroying its simplicity and usefulness. The idea that the effect is due to a slow cooling would also have to be abandoned.—Observations on the preceding note, by M. Marcel Bertrand. A detailed reply to the criticisms of M. de Lapparent.—Preparation and properties of a manganese perfluoride, by M. Henri Moissan. The new fluoride has the composition $Mn_2F_6$, and is formed by the action of fluorine gas upon manganese iodide.—A tubular furnace, working at any fixed temperature, by M. Armand Gautier. An application of the reverberatory principle to a combustion furnace.—Morphology of the pelvic girdle in Amphibia, by M. Arm. Sabatier.—On the Dinosaurians in the strata of Rognac and Vitrolles at the foot of Montagne-Noire, by M. Charles Depéret.—Prof. E. Fischer was elected a Correspondant for the Section of Chemistry.—Observations of the Giacobini comet (1900 *a*) made at the Observatory at Algiers with the 31·8 cm. equatorial, by MM. Rambaud and Sy.—New determinations of *g*, by M. J. Collet. A study of the deviations from the normal value in the neighbourhood of a mountain mass. The mean results at Grenoble, Saint-Agrève, and Le Lautaret are given.—On a theory of systems of total differential equations of the second order, by M. Ernst Pascal.—On the electric charge of the deviable rays of radium, by M. P. Curie and Mme. M. P. Curie. The authors prove that that part of the radiation from radium which is deviated in a magnetic field carries a negative charge of electricity, in a similar manner to the kathode rays. Parallel experiments carried out with the Röntgen rays showed similar effects, but to a very slight extent, and the conclusion is drawn that if the X-rays are charged with electricity, they are much more feebly charged than the radium rays.—Disymmetry in the polarised emission of a Geissler tube submitted to the action of a magnetic field, by M. R. Dongier.—On the constitution of the yellow sodium rays, by MM. Ch. Fabry and A. Perot. An application of the interferential spectroscope previously described by the authors. The complicated and variable results obtained by M. Michelson with the D-lines are here shown to be due to the reversal of the rays. Sodium vapour possesses an enormous absorptive power, even at a low temperature and very feeble pressure.—On the spectra of the polar aurora, by M. Paulsen.—On the preparation of the phosphides of iron, nickel, cobalt and chromium, by M. Georges Maronneau. Phosphide of copper heated in the electric furnace with either of these four metals to a temperature above the boiling point of copper, gives the phosphide of the metal added, which can be extracted in a pure state by treating the fused mass with nitric acid. The properties of $Fe_2P$, $Ni_2P$, $Co_2P$ and CrP are described.—On eugenol, safrol and propylpyrocatechol, by M. Raymond Delange. The methyl ether of eugenol, reduced with sodium and boiling alcohol, gives propylveratrol, which on hydrolysis with hydrochloric acid furnishes propylpyrocatechol.—On the diazotising of safranine, by M. George F. Jaubert. When diazotised under ordinary conditions the monodiazo-compound is the only product. Both the red mono-acid salt and the blue di-acid salt give the same result, but the green tri-acid salt uses twice as much sodium nitrite, and hence corresponds to an azonium base of orthoquinonoid structure.—The modifications brought about by a longitudinal traction in the stems of plants, by M. Thouvenin. In the plant studied, *Zinnia elegans*, a moderate longitudinal pull retards the development of the secondary fibro-vascular bundles.—Variations in the characters of species of haricots under the influence of grafting, by M. Lucien Daniel. An investigation to determine how far the properties acquired by grafting can be transmitted in the case of an annual, such as haricots, by the seed. It is found that grafting always produces variation in the plants grown from seed, this variation being less marked in wild species grafted between themselves, and more accentuated in the cultivated plant.—The work of spinal nervous centres, by Mlle. J. Joteyko. The nerve may be excited for more than four times the period producing fatigue in the muscle, without showing signs of fatigue. The spinal nervous centres thus show a very high resistance.—New method of measuring the tactile sensibility to pressure of mucous and cutaneous surfaces, by MM. Ed. Toulouse and N. Vaschide.—Concerning the physiological alternation of the kidneys, by MM. E. Bardier and H. Frenkel. The experiments quoted show that there is no real physiological alternation of the kidneys, neither from the point of view of the vaso-motor phenomena nor from that of the flow of urine.—Hepatic glycogen during pregnancy, by MM. A. Charrin and A. Guillemonat.

## NEW SOUTH WALES.

**Royal Society**, December 6, 1899.—The President, W. M. Hamlet, in the chair.—On the Darwinias of Port Jackson and their essential oils, by R. T. Baker and H. G. Smith. The authors show that one of the species of the genus—the shrub, botanically known as *Darwinia fascicularis*, A. Rudge—which occurs plentifully on the sandstone formation around Port Jackson, is a plant of great commercial importance in regard to its essential oil. This plant belongs to the natural order Myrtaceæ, a genus so prolific in oil-yielding species. The oil consists principally of the important ester geranyl acetate, the least amount of this constituent being 56·7 per cent. and the greatest 65·1 per cent., obtained from the oil distilled in November. Besides this ester, 13·11 per cent. of free alcohol was determined, calculated as geraniol.—On New South Wales copper ores containing iodine, by Arthur Dieseldorff. The author (who was on a visit to New South Wales a few years ago) was interested in the discovery of iodine in a sample of cuprite from Cobar by Dr. W. Autenrieth, of the University of Freiberg, Baden. He made further investigations himself as shown by the paper, resulting in his proving the presence of iodine in several different samples sent to him from the colony.—Orbit elements Comet I. 1899 (Swift), by C. J. Merfield. The orbit elements have been deduced from the observations taken at most of the leading observatories. Sixteen equations of condition have been employed in finding the corrections to the assumed parabolic elements. The result of the investigation seems to indicate that the geometrical figure described by this comet is an hyperbola.—On the composition of New South Wales labradorite and topazes, with a comparison of methods for the estimation of fluorine, by G. Harker. The paper gives the composition and properties of a typical labradorite from New England, New South Wales, and also the composition including the water of constitution of two varieties of topazes found in New South Wales, one from the Mudgee the other from the New England district. It describes also the results obtained for the percentage of

fluorine in topaz by three different methods, viz. by fusing the topaz with alkaline carbonates alone (Wöhler), by liberating the fluorine as silicon tetra-fluoride and weighing as potassium silicon-fluoride (Liversidge), and by decomposing with alkaline carbonates and silica (Berzelius-Rose). The last method gave the best results, and very probably the whole of the fluorine is obtained by this method.—Note on a remarkable increase of temperature after dark at Seven Oaks, Macleay River, by Hugh Charles Kiddle.—Records of rock temperatures at Sydney Harbour Colliery Birthday Shaft, Balmain, Sydney, by J. L. C. Rae, E. F. Pittman and Prof. T. W. E. David.—The deep sinking now being carried on at the Sydney Harbour Colliery, Balmain, with which one of the authors is actively associated, affords a very favourable opportunity of noting the nature and temperatures of the various rocks underlying the neighbourhood of Sydney, and this the authors are utilising. The paper read deals with the temperatures noted to a depth of 1450 feet, which was the depth reached in the shaft at the middle of November. The thermometers used were specially supplied by Prof. Everett, F.R.S., Secretary of the British Association Committee on the subject of underground temperatures. If the mean annual temperature of Sydney be taken as 63° Fahr., the rate of increase is shown, by the observations made, to be at the rate of 1° Fahr. for every 90½ feet. A remarkable increase of temperature was noted as the sinking passed from the Hawkesbury Sandstones into the Narrabeen Beds, the upper section of which consists of chocolate shales.—Note on the edible earth from Fiji, by the Hon. B. G. Corney, Prof. David and F. B. Guthrie. The sample of edible earth, a soft, pale pink, clayey material, with occasional lumps of chalcedony, was collected by Dr. Corney, near the northern coast of Vanua Levu. Silica, alumina and combined water are present in approximately the proportion required by the formula $Al_2O_3(SiO_2)_2(H_2O)_2$; the substance appears, therefore, to be a silicate of that composition—probably kaolinite—with about 7·6 per cent. of uncombined ferric oxide as mechanical impurity.

## DIARY OF SOCIETIES.

*THURSDAY*, MARCH 15.

ROYAL SOCIETY, at 4.30.—Total Eclipse of the Sun, January 22, 1898. Observations at Viziadrug: Sir N. Lockyer, K.C.B., F.R.S., Captain Chisholm-Batten, R.N., and Prof. Pedler, F.R.S.—A Comparative Crystallographical Study of the Double Selenates of the Series $R_2M(SeO_4)_2$. $6H_2O$. Part I. Salts in which M is Zinc: A. E. Tutton, F.R.S.—The Theory of the Double Gamma Function: E. W. Barnes.

ROYAL INSTITUTION, at 3.—Recent Excavations in Greece: Dr. C. Waldstein.

LINNEAN SOCIETY, at 8.—Report on the Botanical Results of an Expedition to Mount Roraima, in British Guiana, undertaken by F. V. McConnell and J. J. Quelch, W. Botting Hemsley, F.R.S., and others.—Eryozoa from Franz Josef Land, collected by the Jackson-Harmsworth Expedition, 1896-97: A. W. Waters.

CHEMICAL SOCIETY, at 8.—The Vapour Densities of Dried Mercury and Mercurous Chloride: H. Brereton Baker.—(1) The Preparation of Pure Hydrobromic Acid; (2) A New Sulphide of Arsenic: Dr. A. Scott, F.R.S.—The Action of Iodine on Alkalis: R. L. Taylor.—The Interaction between Sulphites and Nitrites: Dr. Edward Divers, F.R.S., and Dr. Tamemasa Haga.—New Polysaccharides: Manno-galactan and Lævulo-mannan: Julian L. Baker and Thomas H. Pope.

*FRIDAY*, MARCH 16.

ROYAL INSTITUTION, at 9.—Pictorial Historical Records: Sir Benjamin Stone.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Measles: its Distribution and Control: Dr Robinson.

*SATURDAY*, MARCH 17.

ROYAL INSTITUTION, at 3.—Polarised Light: Lord Rayleigh.

*MONDAY*, MARCH 19.

SOCIETY OF ARTS, at 8.—The Photography of Colour: E. Sanger Shepherd.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in the Patagonian Cordilleras: Dr. Hans Steffen.

*TUESDAY*, MARCH 20.

ROYAL INSTITUTION, at 3.—Structure and Classification of Fishes: Prof. E. Ray Lankester, F.R.S.

SOCIETY OF ARTS (Foreign and Colonial Section), at 4.30.—Imperial Telegraph Communication: Sir Edward A. Sassoon, Bart.

ZOOLOGICAL SOCIETY, at 8.30.—Field Notes on some of the East African Mammals (illustrated with Lantern Slides): S. L. Hinde.—On a Case of Homœosis in *Asellus*—Antennule replaced by a Mandible: W. Bateson, F.R.S.—On Echinoderms from Singapore and Malacca: F. P. Bedford.

ROYAL GEOGRAPHICAL SOCIETY, at 4.—Twelve Years' Work of the Ordnance Survey: Colonel Sir John Farquharson, K.C.B.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Great Central Railway Extension—Northern Division: F. W. Bidder.—The Great Central Railway Extension—Southern Division: F. Douglas Fox.

ROYAL PHOTOGRAPHIC SOCIETY.—A Demonstration of the Heliogravure Process: Ignatz Herbst.

ROYAL STATISTICAL SOCIETY, at 5.30.

*WEDNESDAY*, MARCH 21.

SOCIETY OF ARTS, at 8.—The Use and Abuse of Food Preservatives: Dr. Samuel Rideal.

GEOLOGICAL SOCIETY, at 8.—On a Bird from the Stonesfield Slate: Prof. H. G. Seeley, F.R.S.—The Lower Ludlow Formation and its Graptolite-Fauna: Miss Ethel M. R. Wood.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Ether Sunshine Recorder: W. H. Dines.—Remarks on the Weather Conditions of the Steamship Track between Fiji and Hawaii: Captain M. W. C. Hepworth.—Comparison by means of Dots: Alexander B. MacDowall.

ROYAL MICROSCOPICAL SOCIETY, at 8.30.—Exhibition of Slides of New, Rare, and Foreign Rotifera, by C. F. Rousselet.

ENTOMOLOGICAL SOCIETY, at 8.

*THURSDAY*, MARCH 22.

ROYAL SOCIETY, at 4.30.—The Croonian Lecture: Immunity, with Special Reference to Cell Life: Prof. Paul Ehrlich (of Frankfort-on-Main).

ROYAL INSTITUTION, at 3.—Equatorial East Africa and Mount Kenya: H. J. Mackinder.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Storage Battery Problems: E. J. Wade.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Adjourned Discussion on Improvements in the Longworth Power-Hammer, and Portable Pneumatic Tools.—*Paper to be read:* Observations on an Improved Glass Revealer, for Studying Condensation in Steam-Engine Cylinders and rendering the Effects Visible: Bryan Donkin.

*FRIDAY*, MARCH 23.

ROYAL INSTITUTION, at 9.—Some Modern Explosives: Sir Andrew Noble.

PHYSICAL SOCIETY, at 5.—An Electromagnetic Experiment: Prof. S. P. Thompson, F.R.S.—(1) Some Experiments illustrating Syntony; (2) An Electrical Micrometer: P. E. Shaw.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Development of the Modern Locomotive Engine: J. W. Cross.

*SATURDAY*, MARCH 24.

ROYAL INSTITUTION, at 3.—Polarised Light: Lord Rayleigh.

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